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W. H. O. I.
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THE JOURNAL

OF THE

Quekett Microscopical Club.

On a New British Sponge of the Genus *Microciona*.

By J. G. Waller.

(*Read November 23rd*, 1877.)

Plates I. II.

The Sponge, which I have the pleasure of bringing before you, was found in a deep cleft on the under side of a boulder of the New Red Sandstone, off Paignton, in Torbay, at about the ordinary low tide mark. The locality is well known to our naturalists, both past and present. The Rev. Charles Kingsley, in his "Glaucus," has eloquently descanted on the abundant riches of the place, which afforded him much enjoyment in the study of natural history. Following the retiring tide, especially if it be at the equinox, you have ample leisure for an examination of those fringes of the rocks where a certain class of sponges are found in considerable quantity. These are for the most part "coating sponges," or those which like to fix themselves in narrow fissures; and that which I bring before you as yet undescribed and new to our fauna, belongs to the first class, and to the genus established by Dr. Bowerbank, under the name of *Microciona*.

The characters which distinguish the genus are thus set forth in the second volume of the "Spongiadæ," p. 7, as having "a common basal membrane, whence spring, at or about right angles to its plane, numerous separate columns of spicula, intermixed with keratode, furnished externally with spicula, which radiate from the columns, at various angles, towards the dermal surface of the sponge." Dr. Bowerbank has tabulated twelve varieties, all of

which are distinct and more or less interesting ; and that which he now calls *Microciona plumosa* has long been known to our naturalists, having been first described by Colonel Montague, who must have been very familiar with Paignton shore, under the name of *Spongia plumosa*. Here it grows abundantly, often in large patches, of a deep orange-red colour. Most of the genus hitherto described are found to range from a deep yellow to the deepest blood-red, as in *M. atrasanguinea;* but that which I am about to describe is of a deep olive green when living, and of a pale olive tint when dry. So in colour it is distinct from all its congeners. But every student of the Spongiadæ knows that colour is a variable condition, and one must never rely on its being constant, when only one example has been discovered, as in this instance. Were this, then, the only difference, it could not stand as a variety. Fortunately, there is a structural distinction, which leaves this matter in no doubt whatever. Amongst the various forms of retentive spicules, none of the sponges of this genus, at present made known, have the bihamate form common to a large number of the silicious sponges. So, as these are found upon the membranes of the example under consideration, it is clearly a well-marked variety.

The small coating sponges, not only belonging to this but to allied genera, well deserve the attention of microscopists ; for without the microscope many would be utterly lost to us ; and all require that instrument to detect and display the minute and curious forms of spicula which are discoverable in their tissue—almost as difficult of resolution, and certainly as interesting, as the markings of the Diatomaceæ. Many of the *Microciona*, with the long flexuous columns of their skeleton, are singularly beautiful objects under the low powers, and cannot fail to interest the most common observer.

The sponge before you is but a small portion of that I discovered, but it was with difficulty I obtained it from its narrow secluded habitat. As you see, it covers a piece of the Red Sandstone, very thinly ; its stoutest part not rising above the eighth of an inch, whilst the average thickness is less than half that. Alive it was smooth, slightly undulating, sarcode abundant, neither oscula nor pores very distinct, the former few in number. In the dried condition, the oscula are more easily discernible ; they are dispersed and generally separate, but sometimes two are found together.

The skeleton columns are in length intermediate, not being quite so long as in *M. plumosa*, when the latter is fully developed and they

occasionally send out a branch. The basal and dermal membranes are alike in character, being thin and pellucid, both having a network of fine cylindrical spicula, the terminations acutely pointed, and with retentive spicula of the bihamate form, contort and sigmoid, of various sizes, though the smaller must, I think, be regarded as immature in growth. Besides these, are others of the anchorate description, though less in number, yet occasionally abundant. The larger kind is tridentate, palmate, equi-anchorate, with a few bidentate equi-anchorate. Of this latter is a smaller variety, more slender in character, having the teeth projected outwards somewhat like the barb of an arrow.

The interstitial membranes are also provided with the two classes of retentive spicula, at times in considerable quantities, often seen attaching themselves to the larger spicula of the skeleton, showing their office to be that of binding the membranes to it as well as together, thus warranting the term "retentive," which Dr. Bowerbank has given to them.

The columns of the skeleton are composed of acuate spicula, more or less spinous, but, like many of the genus, being more pronounced at the base. At the apices they often project through the membrane, giving a hispid appearance to the surface when the sponge is dry, but not visible in its living condition. Spicula of a similar character also project at various angles from the columns. Besides these there are smaller spicula attenuato-acuate entirely spined.

In calling attention to the analogies with known species, mention has already been made of *M. plumosa* in relation to the size of the skeleton columns. The spicula are very similar in character to many of the genus, but those of the skeleton are mostly like to those in *M. fictitia*, differing, however, from all in having no inflation at the base. The tridentate-palmate form in the membranes resembles that in *M. ambigua*, and the angulate-bidentate is found in no less than seven out of the twelve species already described. The bihamate forms, which are found alone in this species of the genus are sometimes so abundant on the dermal membrane as to appear closely matted together, especially between the intervals of the apices of the skeleton columns, and are of all sizes, some exceedingly minute, but undoubtedly these must be considered as immature, as before stated. A close examination of the membranes will amply repay the observer in minute structure. There is evidently order in

what at first sight would appear to be indiscrimination ; you may trace the bihamate spicules interlocking with each other, here and there held and hooked by the fluke of an anchorate form, and the more rarely observed bihamate reversed or sigmoid spicule may be seen twining about one of the skeleton, helping to hold on the membranes as well as to keep them together. (*Vid.* pl. I., fig. 5, 6).

The reproductive organs at present remain unknown, as I am not sure if the object seen in some of my preparations are other than small masses of sarcode. None of the so-called gemmules have been found in any of the genus except *M. armata.*

There are a greater variety of spicula in this species than in any of its class, reminding one very much of those in *Halichondria incrustans*, to which the bihamate forms seem to make an alliance. The latter are most abundant in those areas of the dermal membrane which lie between the projecting apices of the skeleton columns, when they sometimes interlace with each other in a curiously compact manner, and it is probable that here the pores would be found, but I could not perceive them.

Having thus given a general description of this most interesting species, it is now necessary to give it a name. Of course this is provisional, in case it may already have been described by another, or may be amongst those thirty or forty additions which our lamented friend Dr. Bowerbank had made since the publication of his third volume of the "Spongiadæ." Already, indeed, was this example packed with others to be sent for his inspection, when his death occurred. The name I propose has reference to its structural differences which the bihamate spicule gives us, viz., *Microciona bihamigera.*

Following Dr. Bowerbank's formula, the Sponge may be thus tabulated :—Sponge, coating, thin ; colour, when alive, olive green ; dry, a paler tint of the same. Surface smooth when alive, in the dry state somewhat hispid. Oscula dispersed, but sometimes two together. Pores inconspicuous. Dermal membrane thin, pellucid, spiculous. Spicula cylindrical, each end abruptly pointed, slender ; retentive spicula bihamate, contort and sigmoid, very numerous ; also tridentate, palmate, equi-anchorate, and a few bidentate equi-anchorate large and small dispersed. Skeleton columns long and sometimes branched. Spicula acuate, spinous, spines more pronounced at the base ; defensive spicula the same ; also shorter ones attenuato-acuate,

entirely spined. Interstitial membranes thin and pellucid ; spicula same as dermal membrane. Habitat, Paignton Rocks, Torbay.

DESCRIPTION OF PLATES I. AND II.

Plate I.

Fig. 1.—*Microciona bihamigera.* Sponge full size, coating a piece of the New Red Sandstone.

Fig. 2.—Spicule of skeleton. 400 diam.

Fig. 3.—Smaller ditto. 400 diam.

Fig. 4.—Cylindrical spicule of dermal membrane. 400 diam.

Fig. 5, 6.—Groups of bihamate andanchorate spicules from the membranes. 725 diam.

Fig. 7.—Portion of the dermis showing the arrangement of bihamate spicules. 80 diam.

Fig. 8.—Tridentate, equi-anchorate, palmate spicule of the membranes. 1150 diam.

Fig. 9.—Bidentate ditto. 1150 diam.

Fig. 10.—Bihamate ditto. 725 diam.

Plate II.

Exhibits a section of the sponge at right angles to its surface, showing, arrangement of the skeleton columns. Some of these are disrupted from their bases of attachment. *a*, shows reticulation of dermal membrane, and some spicules projecting through the latter. 80 diam.

On the "Autographic" Process of Lithography as applicable to the Illustration of Scientific Papers.

By Arthur Cottam, F.R.A.S.

(*Read December 28th*, 1877.)

It will, I doubt not, be readily admitted that the value of many a scientific paper is greatly increased by good illustrative plates. Many papers would be almost unintelligible unless illustrated. And again the value of the illustrations is very much greater when they are drawn by the author of the paper they are intended to illustrate. To have plates drawn by a professional draughtsman is always expensive work, and unless the draughtsman has some knowledge of the objects to be figured, it is a matter of no little difficulty—sometimes almost an impossibility—to explain to him the special features that are to be brought out, and the minute differences and gradations of light and shade upon which the value of a drawing frequently depends.

A process that will enable any one who can draw fairly well—and I suppose all microscopists can draw more or less, at all events they should be able to do so—to draw his own figures, and to have them printed in facsimile in any numbers, and at a very small cost, is a process so likely to be valuable to the members of this Club, that I am anxious to introduce the new "Autographic" process to you, as I believe it will be found to possess all these advantages.

To explain it, I must briefly describe the ordinary processes of lithography.

Drawings on stone are made with a greasy ink, manufactured on purpose, or with lithographic chalk, which is also greasy. The stone, which is very porous, absorbs the grease wherever it is laid upon it. When the drawing is complete, the stone is washed over with gum-water, which soaks into the stone wherever there is no greasy ink or crayon. When the gum is dry, a roller of printing ink is passed over the stone, and the ink adheres to the greasy parts but will not touch the gummed surface, and by renewing the ink any number of impressions can be printed off.

To draw well on stone requires a long apprenticeship, as the drawing has to be reversed, and the surface is not easy to work upon. To overcome the difficulty of reversing, there has been a transfer paper in use for a long time, on which a drawing could be made the right way, which could afterwards be transferred by pressure from the paper to the stone, and then be printed from the stone in the usual way.

Lithographic stones are of two kinds, some have a smooth face, and others a grained surface. Lithographic chalk can only be used upon the latter kind; upon a smooth stone a drawing must be made with ink alone.

The old transfer paper has a smooth face, and like a smooth stone can only be used for a drawing in ink. The face of the paper is very greasy, is not a good colour, and is almost as difficult to work upon as the stone itself. It has the further disadvantage, that ink lines drawn upon it almost invariably spread in the process of transfer to the stone, and the print is consequently much coarser than the drawing.

The "Autographic" Process, which I now wish to introduce to your notice, is simply a transfer paper with a grained instead of a smooth surface. This grained face enables you to draw with the ink as finely as upon the stone, as well as to use crayon for shading, and it has this immense advantage over the smooth paper, that if the ink lines are drawn with ink not too thick, they will be transferred to the stone as finely as they are drawn, the tendency of lines to spread being almost entirely got rid of. The paper is a beautiful colour, and with very little practice is as easy to draw upon as upon ordinary paper.

The "Autographic" paper is made for, and is sold by Messrs. Maclure and Macdonald, of "The Turret" Printing Offices, No. 97, Queen Victoria Street, City. Lithographic Ink is sold in sticks like Indian ink. The proper crayon to use is Lemercier's "Crayon Copal." I believe both the ink and crayon can be obtained at Barbe's, 90, Regent's Quadrant.

A few words as to the *modus operandi*. The paper must be kept free from grease, and should not be touched with the hand more than necessary, as all greasy finger marks (and the skin is generally more or less greasy) will print. You may outline your work upon the paper with a fine hard pencil, but it should be used lightly. To prepare the ink, heat a saucer over a spirit lamp, and while it is

warm rub the ink upon it ; the heat will dissolve a small portion. Add water to what you have rubbed, *but do not rub the stick in water*. The ink should not be used too thick, and should work freely. A pen or brush may be used to draw with, but a fine sable brush is by far the better tool. With a brush there is no fear of injuring the surface of the paper, and with a little practice much finer lines can be drawn with a brush than with a pen. The crayon can be best brought to a fine point by rubbing it down on a piece of emery cloth.

The drawing should be transferred to stone as soon as convenient after being completed, as the ink seems to lose its virtue after a time.

As to cost—a plate the size of our "Proceedings" can be transferred to the stone for about 5s. or 6s., and can then be printed on good plate paper for about 6s. a hundred, including the cost of the paper.

On the Investigation of Floral Development.

By Marcus M. Hartog, M.A., B.Sc., F.L.S.

(*Read December 28th*, 1877.)

(*Abstract.*)

The author commenced with some expression of regret that a subject of such importance should have received so little attention in this country, that the only reference to it in any English text-book was in the latest editions of "Lindley's Introduction to Botany." He recommended its study as of great utility and interest, and proceeded to give some useful hints as to the best methods of procedure. The microscope to be used for the purpose should give clear detail, with powers ranging from 10 to 60 diameters, and must possess freedom from colour; the simple form was better than the compound, as it gave plenty of working distance and side light, with clearer perception of relief. The pattern specially recommended was one by Arthur Chevalier, which had a heavy, steady stand, and a large stage, and admitted of the magnifier being moved in every direction; whilst the doublets supplied by that maker answered the purpose admirably, giving a very large and flat field of view. The needles most suitable were lance-shaped, sufficiently broad at the base, finely tapering towards the point, and sharpened on both edges; with these, practice only would be needed to carry on the finest dissections. Payer and others recommended early morning light as the best to work with, it being grey, as distinguished from the more coloured rays of evening, and illuminating the object under examination in a horizontal direction, which was very advantageous. The process of working consisted in taking off the parts of the flower one by one to see what lay underneath, and in illustration of the process, the author described the manner in which the flower of the Foxglove should be dissected, in order to trace back its origin to the first appearance as a hemispherical elevation on the

axis of the inflorescence. In older flowers it was best to begin by making sections of the ovary, and the best types to begin upon were the racemose *Corolliflorœ*, such as the Foxglove and Snapdragon ; a fresh stem should always be taken, as the various parts quickly began to dry up or become flaccid. The best method of preparation for examination under the compound microscope was to make sections and act on them with a solution of caustic potash, after which having washed them they should be mounted in glycerine, when they would be sufficiently transparent. It was, however, the opinion of the author that this class of objects was shown with greater accuracy under the simple microscope than by the compound. In further illustration of his subject he exhibited Chevalier's microscope already mentioned, together with doublets of 1, 2, 3, 5, and 10 lines focus, and a pair of lance-headed dissecting needles. A copy of the Atlas to Payer's " Organogénie Comparée," showing the various stages of the development of the flower in many natural orders, was also placed upon the table for the examination of the members.

PROCEEDINGS.

August 10th, 1877.—Conversational Meeting.

The following objects were exhibited:—

Tongue of Mouse, injected	Mr. F. W. Andrew.
A Blade of Grass, stained	Mr. T. H. Buffham.
Geophilus longicornis (Snake centipede) ...	Mr. F. Enock.
Leaf of *Dendro-calamus giganteus* (Bamboo)	Mr. W. H. Gilburt.
Aulacodiscus Kittonii	Mr. H. G. Glasspoole
Bladder of Guinea-pig, showing Peyer's Glands	Mr. J. J. Hunter.
Leaf of *Drosera rotundifolia*	Mr. Ingpen.
Graphic Granite, from Portsay (for distribution)	Mr. M. Hawkins Johnson.
Tingus cardui	Mr. W. Moginie.
Parallel Microscope, for camera lucida drawing	„ „
Foraminifera, from Indian Ocean	Mr. B. W. Priest
Cynoglossum sylvatica	Mr. J. W. Reid.
Graphic Granite, from Scotland	Mr. G. J. Smith.
Ptychodus tooth from chalk	„ „

Attendance—Members, 40; Visitors, 3.

August 24th 1877.—Ordinary Meeting.

J. G. Waller, Esq., *in the Chair.*

The minutes of the preceding meeting were read and confirmed.

Mr. A. St. Clair Buxton, Dr. R. C. Croft, Mr. F. Habirshaw, Dr. John Habirshaw, Dr. Parkinson Oates, and Mr. E. B. Turner, were balloted for and duly elected Members of the Club.

The following donations, &c., were announced, and the thanks of the Club voted to the Donors:—

"The Monthly Microscopical Journal" ...	from the Publishers.
"Science Gossip."	„ „
"Proceedings of the Royal Society" ...	„ the Society.
"Transactions of the American Medical Association"	„ the Association.
"Annals of Natural History"	by purchase.
"American Journal of Microscopy" ...	in exchange.
"Proceedings of the Belgian Microscopical Society"	from the Society.

"Medical Examiner." Weekly	„ the Editor.
"Analyst"	„ „
"American Naturalist"	in exchange.
"Report of the Bristol Naturalists' Society"	from the Society.
Photographs of Mr. H. G. Glasspoole and Mr. F. Grayling.	
Specimens of *Drosera rotundifolia*, for distribution	Mr. Priest.

Mr. Ingpen described a method of oblique illumination exhibited in the room by Dr. Dickson, of Glasgow. An ordinary bull's-eye condenser was placed with its convex side uppermost and its flat side nearly horizontal, and reflected the light in the same manner as an Amici prism, and with very good effect. It was of great use to know that an appliance like a bull's-eye, which was almost always at hand, could be turned to such good account.

Mr. Ingpen then gave a description of the various forms of camera lucida which had been devised for landscape drawing, and for use with the microscope. First explaining the principles upon which the camera lucida was constructed, he proceeded to describe various forms devised by Dr Wollaston, Amici, Soemmering, Beale, Nachet, Doyère, Nobert, Chevalier, and others. Particular reference was made to Goring and Pritchard's micographia (1837, p. 221, "Quekett," on the Microscope, 3rd ed., 1855, pp. 167, 253; Carpenter on the Microscope, 5th ed., 1875, p. 127. *et. seq.*; "Quarterly Journal of Microscopical Science," vol. viii., p, 156; and attention was drawn to the utility of the camera lucida, as a check upon "fancy drawing," as offering facilities for making rapid and faithful sketches of living objects, and of cultivating habits of accurate observation. Nearly all the forms described were exhibited in the room.

Dr. Cooke said that he had been in the habit of using Nachet's camera lucida almost daily for some years, and found it of the greatest advantage. Any difficulty in seeing the pencil could easily be overcome by using a second lamp, as generally the object was too bright, and the pencil in consequence indistinct. He always used a microscope in a fixed position, with the camera attached and ready for use at a moment's notice; and some careful measurements having been made once for all, the sizes of objects examined, and the extent to which they were magnified, could also be recorded with each drawing.

In answer to a question, Mr. Ingpen said that the difficulty found by many persons in using the Wollaston camera was caused by their keeping the eye too far over the prism.

Mr. Curties advocated the use of squared paper, as being in some respects more convenient than the camera, and said that Mr. Suffolk had expressed a similar opinion.

The thanks of the Meeting were voted to Dr. Dickson and Mr. Ingpen for their communications.

The Chairman announced the engagements for the ensuing month, and

the meeting terminated with a conversazione, at which the following objects were exhibited:—

Stained stem of *Equisetum limosum*	Mr. T. H. Buffham.
Hydra vulgaris	Mr. G. Carr.
Diatoms shown with bull's-eye condenser ...	Dr. Dickson.
Thoridion lineatum	Mr. F. Enock.
Aulacodiscus Kittonii. 5 rays...	Mr. Hailes.
Ditto ditto, 8 rays	,, ,,
Acari found in a damp mouldy book	Mr. A. H. Halley.
Triceratium septangulatum, illuminated with polarized light and coloured ground	Mr. E. M. Nelson.
Surirella gemma, under 1-16 object-glass ...	Mr. H. J. Roper.

Attendance—Members, 45; Visitors, 8.

September 14th, 1877.—Conversational Meeting.

The following objects were exhibited:—

Web of *Ciniflo atrox*	Mr. F. Enock.
Pulex vespertilionis, male and female... ...	Mr. H. E. Freeman.
Scalariform vessels from *Pteris aquilina* ...	Mr. W. H. Gilburt.
Phylloxera vastatrix	Mr. H. G. Glasspoole.
Wing of "Red Admiral" butterfly	Mr. A. H. Halley.
Section of Human Fallopian Tube	Mr. J. J. Hunter.
Leaf of *Drosera Anglica*	Mr. J. E. Ingpen.
Laurentian Quartzite from Iona	Mr. M. Hawkins Johnson.
Glands of leaf of Hop...	Mr. A. Martinelli.
Oral Membrane of *Echinus*, showing Pedicellaria, &c..	Mr. B. W. Priest.
Human ovum	Mr. E. Richards.

Attendance—Members, 53; Visitors, 7.

September 28th, 1877.—Ordinary Meeting.

Henry Lee, Esq., F.L.S., &c., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following gentlemen were balloted for and duly elected members of the club:—Mr. John Hagger, Mr. Robert Headley, Mr. Henry Pocklington Mr. Kenneth J. Tarrant, and Mr. Thomas P. Watson.

The following donations to the club were announced:—

"The Monthly Microscopical Journal"	... from the Publishers.
"Science Gossip"	,, ,,
"Proceedings of the Royal Society" ...	,, Society.
"The Medical Examiner" (weekly) ...	,, Editor.

"The Annals of Natural History"	...	by purchase.
"The American Naturalist"	...	in exchange.
"Proceedings of the Belgian Microscopical Society"	...	from the Society.
Ten slides	...	Mr. F. Coles.
Photographs of *Physalis*	...	Dr. Habirshaw.

The President said that in addition to the foregoing list, a special gift had been made to the club, which they could not possibly include in the usual vote of thanks to the donors. Mr. Crouch had presented to them a magnificent binocular microscope stand, which was placed upon the table before them. Without further enlarging upon its merits, or upon Mr. Crouch's liberality, he would ask them to pass a special vote of thanks for this very valuable present. They would observe that in the box containing the instrument Mr. Crouch had wisely left a number of vacancies for the reception of objectives and various apparatus, and he threw this out as a hint to members that any future donations would be acceptable.

A vote of thanks to the donors and a special vote of thanks to Mr. Crouch for his valuable gift were unanimously passed.

Mr. Chas. Stewart then delivered an address to the members "On the Histology of the Human Skin." As regarded the physical properties of the skin and its general appearance, it might be described as that structure with which the whole surface of the body was invested; it was flexible, tough, strong, and elastic; these properties rendered it eminently fitted for the protection of the more delicate structures within; and being on the surface of the body it likewise had to be sensitive to the touch and to alterations of temperature. It also afforded means by which various waste products were poured out, which, if retained, would be highly injurious to the system. It was not alike all over the body, but might be divided into the common skin which covered most of the surface, and which was more or less covered with hair, and the palma and planta skins of the hands and the feet on which no hair grew. Taking that portion of the skin which formed the chief covering of the body, it was found to be divided into two layers—the Epidermis or scarf skin and the deeper layer known as the Dermis or true skin. The Epidermis was composed almost entirely of minute cells, which had upon their surface a vast number of small spine-like processes. Formerly it was held that these spines were of use for interlocking with those of other cells, but more recently they had been taught that this was not the case, but that they were opposed to one another; for his own part, however, he inclined to the belief that the interlocking was the rule and the opposition the exception. The cells were built up in layers—the outer one being the horny layer and the inner being a living layer known as the "rete-mucosum." Between the two there was a special transitional layer known as "Schon's" layer, and besides this it was exceedingly probable that certain processes of the dermic cells also penetrated amongst the cells of the Epidermis, which also received the delicate nerve fibrillæ that passed into it from the Dermis. Beneath the Epidermis came the Dermis or true skin, and the exceeding

toughness of this was due to bundles of fibrous tissue interlacing in every direction, and forming a very deep layer, at the bottom of which fat cells were introduced. These bundles were also surrounded and intermixed with cells, and for the nutrition of the skin there were provided numerous canals and blood vessels, which, like blood vessels everywhere else, were found in positions of least pressure, occupying the spaces between the bundles. Nutriment was thus conveyed, and life was kept up, a fluid was exuded which saturated the cells, and the surplus was drained off by a set of tubes—the lymphatics or drain tubes. Mr. Stewart then proceeded by means of numerous drawings in coloured chalks upon the black board to describe and explain the position and structure of the Sudoriporous and Sebaceous glands and follicles, the general appearance of the sweat gland and its upward spiral course to its outlet through the epidermis being very clearly shown. The complicated structure of the hair follicle was next pointed out, and the Dermic and Epidermic origin of the root sheath—the layers of which it was composed, the structure of the hair itself, together with its means of nutriment, and its erector muscles—were severally explained; and a short description of the peculiarities of the skin upon the palm and sole—which were chiefly distinguished by the absence of hair, regularity of the sweat glands, greater size of the papillæ, arranged in rows, and different arrangement of the touch corpuscles—brought a highly interesting and instructive address to a close. In addition to the diagrams which were drawn by Mr. Stewart as he proceeded, the subject was further illustrated by numerous preparations exhibited under microscopes in the room.

Mr. T. C. White said he had seldom had the pleasure of listening to a more lucid explanation of a complicated subject than that which Mr. Stewart had given them. Mr. Stewart had told them all about the growth of straight hair, but he should like to ask him if he could account for the very curly hair of the negro?

Mr. Stewart was afraid he could not say what was the original cause of the curling of the hair; he had examined the negro's scalp and believed it to be a matter of race. It was a curious fact that in making a section of the scalp the hair follicle was found to have a curled direction, so that the whole thing—follicle and hair below the skin, as well as above it—was all curly together. He had a slide in which this peculiarity was well shown.

The President said that Mr. Stewart's knowledge was so complete, and his explanations were so clear, that it was always a pleasure to listen to him, and he was quite sure that all present would feel that what they had heard that evening was no exception to the rule.

The thanks of the meeting were unanimously voted to Mr. Stewart for his interesting communication.

Announcements of meetings, &c., for the ensuing month, were then made, and the proceedings terminated with a conversazione, at which the following objects were exhibited:—

Sections of Human Skin	Mr. W. J. Brown.
Section of bladder of *Utricularia vulgaris*	Mr. T. H. Buffham.

Seed of Honeysuckle	Mr. A. L. Corbett.
Arranged Diatoms	Mr. A. C. Cole.
Pea Blight	Mr. F. Coles.
Fructification of *Blechnum spicant* ...	Mr. W. H. Gilburt.
Tongue of *Eristalis narcissi*	Mr. J. W. Goodinge.
Wing of Silver Studded Blue Butterfly ...	Mr. A. H. Halley.
Starch Granules	Mr. Martinelli.
Stictodiscus Buryanus	Mr. Moginie.
Selected Diatoms	Mr. J. H. Powell.
Aulacodiscas Kittonii	Mr. H. J. Roper.
Sections and preparations of Human Skin	Mr. C. Stewart.

Attendance—Members, 79; Visitors, 10.

October 12th, 1877.—Conversational Meeting.

The following objects were exhibited:—

Gizzard of Earwig	Mr. F. W. Andrew.
Stained pinnule of *Pteris aquilina* ...	Mr. T. H. Buffham.
Wing of Diamond Beetle	Mr. F. Coles.
Ciranium ciliatum	Mr. C. G. Dunning.
Forficula auricularia	Mr. F. Enock.
Section stem of *Dahlia*	Mr. W. H. Gilburt.
Diatoms from Whissonsett, Norfolk ...	Mr. H. G. Glasspoole.
Difflugia aculeata	Mr. J. E. Ingpen.
Basalt from Staffa and other localities ...	Mr. M. Hawkins Johnson.
Daphnia, &c.	Mr. A. Martinelli.
Lichmophora flabellata (alive)	Mr. A. D. Michael.
Selected Diatoms	Mr. H. J. Roper.
Arranged scales of Goat Moth	Mr. T. P. Watson.

Attendance—Members, 55; Visitors, 3.

October 26th, 1877.—Ordinary Meeting.

Henry Lee, Esq., F.L.S., &c., President, *in the Chair*.

The minutes of the preceding meeting were read and confirmed.

The following presents to the Club were announced:—

"The Monthly Microscopical Journal" ...	from the Publishers.
"Science Gossip"	" "
"The Popular Science Review"	" "
"The American Naturalist"	in exchange.
"Coal at Home and Abroad," by J. R. Leifchild, A.M.	from the Author.
Le Maout and De Caisne's "Descriptive and Analytical Botany"	by Purchase.
Huxley's "Anatomy of the Invertebrata" ...	" "

The Plates illustrating "Baker on the Microscope"	Mr. Hawkins Johnson.
Quaritch's "Catalogue of Books"	from the Publisher.
"Annals of Natural History"	by purchase.
"The American Journal of Microscopy" ...	from the Editor.
"The Medical Examiner." Weekly	„ the Editor.
"Proceedings of the Belgian Microscopical Society	„ the Society.

Photographs for the Album of Mr. S. A. Johnson, Mr. W. W. Reeves, Mr. Alpheus Smith, and Mr. Topping were also presented.

The thanks of the Club were unanimously voted to the donors.

The following gentlemen were balloted for and duly elected Members of the Club:—Col. H. Basevi, Mr. J. L. Luscombe, Mr. Bernard Smith, Mr. Saml. Smith, Mr. G. H. Wallis, Mr. W. Walters, and Capt. Weatherley.

The President announced the forthcoming Soirée of the Croydon Microscopical Club, and invited the assistance of such members of the Q. M. C. as might be able to be present on the occasion.

Dr. James Edmunds then addressed the meeting "On a new Immersion Paraboloid Illuminator." He commenced by drawing the attention of the members to two objects—*Amphipleura pellucida* and *Podura Scale*—exhibited in the room, in order to illustrate the action of the Illuminator which he was about to describe. The first was an ordinary valve of *A. pellucida*, measuring about ·005 inch in length, and marked with transverse lines counting more than ninety thousand to the inch, the valve being displayed upon a soft black background, and its lines with their interspaces showing as brilliant green and black bands. These lines and their interspaces—together measuring in round figures, nearly 200,000 to the inch—were distinctly separated, and made visible to the eye. The valve was seen through an immersion 1-16th by Powell and Lealand and, so far as he (Dr. Edmunds) had learnt, *A. pellucida* had never been shown thus by any illuminator that had previously been devised. The Podura was an ordinary scale of *Lepidocyrtus curvicollis*, lying in air, solidly upon the slide, with a thin cover close over its upper surface. The objective was a new-formula immersion $\frac{1}{8}$th, by Powell and Lealand. It would be observed that a brilliant *positive* image of the podura scale—also upon a perfectly black background—was seen, and that the "markings" were shown demonstratively as minute featherlets, projecting up from the scale membrane. Podura Scale appeared to resemble a mat in structure, but its membranous basis was so hyaline that, under this light it blended with the slide, and transmitted light into the featherlets without itself becoming luminous. By shifting the lamp from side to side, or by altering the mirror to a small extent, these featherlets were seen to become shaded on either side, and on further alteration their images became so blended as to render optical definition impracticable. In a particular light the tips only of the featherlets were illuminated, and these tips appeared as brilliant beads arranged on the scale in exact accordance with those ends of the markings which were towards the free end of the scale. This might easily be demonstrated by plotting out the "markings" under one light, their beaded tips—as seen

by the other light—being afterwards counted off or plotted out for comparison. The beads thus shown might also be seen less distinctly by the reflex illuminator and by the Wenham Paraboloid, and they were the heads of the "tadpoles" in what was at present regarded as the true image of Podura. He would venture to designate this as the primary beading of the Podura Scale. Then at a certain point in a very careful illumination, and under amplification of the very finest character, there was a fine beaded structure to be seen in the scale membrane itself, analogous to the beading seen in other scales. This, he would venture to designate as the ultimate beading. It was, in fact, a true beading of the scale membrane itself, while the other, or primary beading was, in reality, due merely to a particular lighting up of the tips of the featherlets, their hyaline shafts and the scale membrane being left invisible, or almost entirely so. The true ultimate beading of the scale membrane was closer than the primary beading laterally by about two to one, while longitudinally it ran about five to one. In order to see the ultimate beading by the paraboloid, it was necessary to light the scale so as to make the featherlets invisible, and when these hyaline projections were not seen except as a thin haze over the image of the scale membrane, the true beading could be discerned. By transmitted light the images of the featherlets and of the scale membrane were necessarily blended together more or less completely, but with fine definition under an amplification of about 2,000 diameters, and with exact illumination they could be demonstratively separated, if only the key given by means of this paraboloid illuminator were fully realised. The definition of Podura featherlets on black background was the best test he had yet seen for the most useful qualities of a high power objective. The ultimate beading could be approached most easily through the study of the scale of the speckled Podura —the structure being more easily resolved in that scale.

Reverting to the illuminator, by means of which he had been enabled thus to unravel the structure of Podura scale, Dr. Edmunds proceeded to explain the construction and action of the Wenham-Shadbolt paraboloid, illustrating his remarks by drawings made upon the black-board, and showing wherein his own paraboloid differed from previous appliances of the same kind. Dr. Edmunds described his paraboloid as cut off at an exactly calculated distance below its focus, this distance varying in the four lenses which constitute the set, and the plane top being made optically continuous, and as nearly as possible optically homogenous with the substance of the slide, by means of a cementing fluid of high refractive index, such as anhydrous glycerine, castor-oil, copaiba-balsam, oil of cloves, or a new fluid—"plumboxyde of glyceryl"—prepared by himself for the purpose. The latter fluid worked exactly like pure glycerine, and could be made of much higher refractive index. Chemically it might be described as glycerine with di-oxide of lead introduced into its molecular structure, in place of its equivalent of hydroxyl, but as he had not completed his work on this refracting medium, he would not now refer to it further. These paraboloid lenses acted upon the principle of total internal reflection, and each one was calculated for the thickness of the slide beneath which it was to be used, so as to converge upon

the object all the light entering the base of the paraboloid. No. 1 lens was calculated for use with a slide of ordinary thickness, say a sixteenth of an inch. No. 2 lens was calculated for use with a slide not exceeding one-hundredth of an inch in thickness, and he had constructed "drum-head" mountings for objects between thin glass, which enabled an object to be viewed and lighted indifferently on both sides. Parallel light should be thrown into the base of the paraboloid, and the most splendid effects were obtained by means of direct sunlight. The object might safely be illuminated up to apparent incandescence, without danger to the objectives. By a set of central stops, peripheral zones, and revolving shutters, the light might be narrowed horizontally, and thrown into the object at any angle and in any azimuth. One curious fact had come out, that the valves, now shown upon the table and so finely resolved under the light of this new paraboloid were not resolvable by Mr. Lealand with his former methods. This was owing to the fact that the valves being set upon the slide, there was a stratum of air between them and the cover which reduced the correction of the lens so much that it lost that extension of angle by which it had power to resolve an *acus* valve when attached to the under surface of the cover—the space between the object and the lens being then wholly occupied by glass-cover *plus* water, instead of as at present partly by air. This fact raised the question how much the value of "angle of aperture," depended simply upon the reception of additional light from the object, how much upon angle *qua* angle. But this he would not now attempt to discuss. It was, however, important to note that the pure brilliant positive image of an object, as given by this paraboloid, was resolvable by a lens with smaller angle of aperture than was another image, and, if we could by new means of illumination increase the resolving power of low angled lenses, a vast gain would be made. The defining and resolving power of an astronomical telescope depend directly upon the area of objective—other things being equal. Here the difference consists purely in bringing into the image a larger number of pencils of light from the planets or other objects, the question of angle *qua* angle not coming into account. The telescopic image is a positive one, and the blacker the field the finer the impression made upon the retina. In the microscope, the *negative image* only being seen by transmitted light, the most luminous area before the eye was necessarily the blank field, while the object was recognized only by its power of obstructing light, and was comparatively weak in its impression upon the retina. With this positive image, on the other hand, there was a soft black background, and the brilliant image of Podura or Acus as thus shown, obviously had immense advantages in regard to its power to impress itself upon the retina. With bacterial fluids the effect was equally remarkable. Saliva, blood, &c., viewed by a good dry quarter of about 95°, were seen almost as new objects, when lighted up by this paraboloid.

Mr. Ingpen said that the Club was highly indebted to Dr. Edmunds for bringing the matter before it, and the subject was certainly one of very great interest. It was also a curious instance of the way in which an invention might be made before the time came for its due appreciation, and

then be re-invented quite independently by others a long while afterwards. It would perhaps be remembered that Mr. Wenham introduced the immersion paraboloid in 1856, and that in 1871 Mr. B. D. Jackson read a paper before the Club on the same subject, the re-invention in that case being by Dr. Barker, but not only was its re-invention by Dr. Edmunds perfectly genuine, but the instrument stands now upon what may be called a different platform, because many improvements have been made in objectives and methods of research. The instrument was now introduced to a more appreciative audience than formerly, and at a time when the subject of the examination of minute structures rested upon a widely different footing from that which existed some years ago.*

Dr. Matthews said that, about two years ago he had come to the conclusion that the "markings" upon Podura scale were really club-shaped projections from the surface of the scale, but he had never been able to demonstrate the fact as Dr. Edmunds had done to-night. He was enabled to say this quite two years ago, though he knew that the idea was then thought to be very heretical. He did not think that they could possibly get both positive and negative images of an object by sub-stage illumination. In the case of translucent objects, they might get them illuminated all round by horizontal rays, but even then they would get a negative image, and they could only get a positive image by light thrown down from above the level of the surface of the object; all forms of illumination that did not exceed the angle of 90° from beneath must necessarily give negative images. Then it must not be overlooked that, in so examining scales, they were looking at objects consisting of two layers, with light entering from beneath. They therefore got confusion between the markings on the upper and lower surfaces which was much apt to mislead. As long as objects were illuminated from beneath, he could not enforce it too strongly that they never could get a positive image.

Dr. Edmunds asked Dr. Matthews to examine the images again.

The President said there was a class of evidence which it would be very desirable to get if possible, seeing that Dr. Edmunds claimed certain advantages and power of definition—perhaps Mr. Powell or some other gentleman with practical knowledge would give them their opinion from experience.

Mr. Powell said he had not tested it upon any other objects than *Amphipleura pellucida*, but he found that it showed the markings in a way which no other method would do.

Dr. Matthews (after examination) said he saw the objects exactly as Dr. Edmunds had described them, but it was quite clear that the illuminating rays approached them from beneath, and that in order to get a positive image the light must fall upon the object from above.

Dr. Edmunds thought there were reasons why he might still ask Dr.

* Note.—Upon the question of priority, Dr. Edmunds writes:—"As between Mr. Wenham and myself, I need only to observe that the paraboloid described by Mr. Wenham was not like mine, either in its formula or in its effects, and that the methods of working and applying the two instruments as accessories to the microscope do not in the least resemble each other."—Ed. J. Q. M. C.

Matthews to re-consider his judgment. In the case of light converging at an angle of 85°, if they took the thickness of the covering glass and of the stratum of air between, and also the thickness of the film of water into consideration, they would see that light passing at an angle of 85° could not enter the objective at all, but could only be seen as light received by the object and again thrown out by it as its own radiant. They saw an object negatively by virtue of its power of obstructing light, whereas, if they could make it receive light to such a degree as to become its own radiant while no light entered the objective except that given out by the object, he apprehended that it must be seen as a positive image. Here it was seen upon a perfectly black background, the Podura scale appearing as if incandescent.

Dr. Matthews said that the principle enunciated by Dr. Edmunds was perfectly correct, but yet he could not see that any object illuminated only from below could afford any other than a negative image when looked at from above—unless light were reflected back upon it from the under surface of the cover.

Dr. Edmunds feared he had not clearly explained; no light could come up through the surface of this slide, except into the substance of the object, otherwise they would of course cease to get the black background.

The President said that the discussion as to positive images opened up a series of complicated questions, which it was clear they could not go into that evening.

A vote of thanks to Dr. Edmunds for his communication was then unanimously carried, and the proceedings terminated with the usual conversazione, at which the following objects were exhibited:—

Section of China rose	by Mr. F. W. Andrew.
Spicules of Holothuria	„ Mr. T. H. Buffham.
Anchors of *Synapta*	„ Mr. F. Coles.
Scalariform tissue of Fern	„ Mr. A. L. Corbett.
Podura scale, *Lepidocyrtus curvicollis* (shown by Dr. Edmunds' immersion paraboloid)	„ Dr. Edmunds.
Strophosonius obesus	„ Mr. Enock.
Scylla, from wet moss	„ Mr. H. E. Freeman.
Sieve tubes from Dahlia	„ Mr. W. H. Gilburt.
Fin of young Carp	„ Mr. Halley.
Nasal Polypus	„ Mr. J. J. Hunter.
Grammatophora marina...	„ Mr. Michael.
Section of Human Tongue	„ Mr. Moginie.
Amphipleura pellucida (by Dr. Edmunds' immersion Paraboloid)	„ Mr. Powell.
Arachnoidiscus ornata	„ Mr. B. W. Priest.
Mignonette	„ Mr. F. Reeve.
Polycistinæ	„ Mr. Swift.

Attendance—Members, 86; Visitors, 14.

November 9th, 1877.—Conversational Meeting.

The following objects were exhibited :—

Asparagine	Mr. F. W. Andrew.
Uraster glacialis	Mr. T. H. Buffham.
Wing of *Retinia resinella*	Mr. F. Enock.
Selected Diatoms	Rev. H. J. Fase.
Section of tuber of *Dahlia*, showing crystals of Inuline	Mr. W. H. Gilburt.
Trichina spiralis	Mr. J. J. Hunter.
Insect mountings from Ceylon	Mr. Ingpen.
Large intestine of Guinea-pig, injected and stained	Mr W. W. Jones.
Chirping file of Cricket	Mr. W. Moginie.
Tranverse section, head of Wasp... ...	Mr. E. T. Newton.
Section of human kidney, injected ...	Mr. J. W. Reid.

Attendance—Members, 43 ; Visitors, 6.

November 23rd, 1877.—Ordinary Meeting.

Henry Lee, Esq., F.L.S.. &c., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following donations to the Club were announced :—

"Science Gossip"	From the Publishers.
"Proceedings of the Royal Society"	,, ,, Society.
"Annals of Natural History"	By purchase.
"Rules of the Royal Society of New South Wales"	,, the Society.
"The American Journal of Microscopy" ...	,, ,, Editor.
"Proceedings of the Belgian Microscopical Society'	,, the Society.
"The Medical Examiner" (weekly) ...	,, the Editor.
"The Analyst"...	,, ,,
"Pamphlets by Dr. Wallich on the North Atlantic sea bed," &c.	,, the Author.
A 1-5th Objective for use with the Club microscope	,, Mr Wray.
15 Slides of Anatomical preparations ...	,, Mr. A. C. Cole.
12 Slides of Vegetable tissues	,, Mr. W. H. Gilburt.
24 Slides of Physiological Preparations ...	,, Mr. J. Hunter.
1 Slide of *Licmophora*	,, Mr. A. D. Michael.

The thanks of the Club were unanimously voted to the donors.

The following gentlemen were balloted for and duly elected members of the Club :—Mr. W. S. Dallas, Mr. W. Goodwin, Mr T. S. Morten, Dr. A. H. Newth, Mr. Thomas Simpson, and Mr. George S. Williams.

The President said that from time to time the question had been brought

before the Committee as to the further utilisation of the gossip nights, and suggestions had been made as to the conducting of some kind of class instruction on those occasions. The committee had always been very careful not to interfere in any way with the informality and freedom of those meetings, and the subject had, therefore, been rather difficult to deal with; but a sub-committee had been appointed to consider the whole question, under instructions that if the idea could be carried out without interference with the ordinary procedure, it would meet with approval. This sub-committee had unanimously recommended that the experiment should be tried, and the committee had agreed to do so. At the next gossip night, therefore, one of the "Bays" in the room would be occupied by a member of the committee, who would give a brief description of the theory and construction of the microscope, to all who chose to attend to listen. The committee would have this matter under strict supervision, in order that the freedom of the members on those occasions should not be in any way interfered with.

Mr. Ingpen said he had a short communication to make, arising out of Dr. Edmunds' paper, read at their last meeting, with reference to his method of mounting test objects. This method was so simple and so good that it was worth drawing attention to it. Dr. Edmunds took a thin slip of cedar wood, 3in. long and $1\frac{5}{8}$ wide, and cut a round hole through the middle $1\frac{1}{4}$ in. in diameter. Over this hole he pasted a piece of the thinnest bank post paper, having a $\frac{5}{8}$in. hole punched in it. The object was then placed between two pieces of thin glass, cemented together, and these were cemented to the paper. The object was thus mounted between pieces of glass, so thin, that it could be reversed and viewed from either side equally well, and the under side admitted of the use of the immersion paraboloid, whilst the paper being elastic, formed as complete a protection to the objective as even a "Stephenson's safety stage."

Mr S. J. McIntire called the attention of the meeting to some larvæ of the cat flea, which he had brought for exhibition that evening. Having shaken out upon a newspaper the basket which his cat and her family had occupied, he found, amongst other things, an immense number of the larvæ of the flea, as well as numerous eggs. The eggs were small, pearly objects, and very pretty under the microscope; and the larvæ were white at first, with a few hairs on them, and divided into 13 segments. The food of the larvæ consisted of the excrement of the flea; in due course the larvæ entered the crysalis state, and finally changed into the perfect insect. There was a paper upon the subject in "Science Gossip" for 1865,* which might, perhaps, be forgotten by those present; he, therefore, thought it might be of interest to bring the subject again before them. The best objective for the examination of the larvæ was a 3in.

Mr. J. G. Waller read a paper "On a new British Sponge of the Genus *Microciona*, for which he proposed the name of *M. bihamigera*. The subject was illustrated by diagrams, and by a specimen of the new species.

Mr Chas. Stewart, at the request of the President, gave an interesting description of the characteristics of sponges generally, in the course of which

* See "Science Gossip," Vol. i., p. 278, and Vol. iii., p. 47.

he said that they were very widely diffused, and were found in the sea at all depths, from between the tide marks to several miles. As a rule, they were very brilliantly coloured objects, and all the species were fixed in various ways, according to their natural habit, or to the position in which they were found. Their varied modes of attachment were then described, and also the beautiful species which anchored themselves to the mud and ooze. *Hyalonema*, *Euplectella*, &c., were figured upon the black-board. The general anatomy of the sponge family was then dealt with, and they were shown to be covered by a dermal membrane, perforated with small holes, the whole mass being traversed by a number of canals, which opened into the subdermal chambers on the one hand, and the oscula on the other. The process by which the currents of water through these channels were set up and maintained was next explained, attention being called to the contractile power possessed by the fleshy portions of the mass. The infinite variety and specific characters of the spicules were next adverted to, and as regarded their mode of reproduction, it was pointed out that they came much nearer to the zoophytes than to the Infusoria.

Mr J. G. Waller expressed the pleasure which he felt at hearing the subject of the *Spongiadæ* brought before the Club in so interesting and able a manner. With regard to the contractile power of sponges, he would just mention that in detaching the sponge from the rock it contracted visibly, and discharged quite a large quantity of water. As to gemmules, he was not quite sure if they were right in calling so many things "gemmules," and thought it very possible that they might have to modify some of their opinions upon this subject.

The President said that when he looked at the drawings of the species described by Mr. Waller, it struck him that he was in some way familiar with it, but whether it was one which had been shown to him by his late friend, Dr. Bowerbank, under his microscope, or whether it was figured amongst the plates which were prepared as illustrations for the 4th Volume of "The British Spongidæ," he could not say from memory. It would, however, gratify them very much if it should turn out that a new species had been discovered by a member of the Club. Since Dr. Bowerbank's time some modifications had already been made, and it was curious to remember that with regard to *Hyalonema* they could never get him to acknowledge the fact that it grew the right way upwards, and he always would call it the "basal sponge," but they knew better now. The study of sponges offered a very wide field for research, and though some observers abroad were doing a little, they might say that there was no one in England who was making a study of them, now that Dr. Bowerbank was gone; he would, therefore, venture to urge it upon the consideration of the members how vast was the field before them, and if the paper of that evening was the means of inducing others to take up the study, he should be heartily glad.

The thanks of the meeting were then unanimously voted to Mr. Waller and Mr. Stewart for their communications.

Mr. Ingpen called the special attention of the members to the slides which had been presented to the Club by Mr. Cole, Mr. Hunter, and

Mr. Gilburt as being beautiful and valuable additions to the cabinet. With reference to the "elementary gossips" proposed, he wished it to be understood that they were at present to be considered as quite an experiment, rendered desirable by the fact that some of the members had expressed to him a wish for microscopical instruction of an elementary character. He had undertaken the first of the series, and hoped that whatever the result might be, the members would give him credit for the motives which actuated him in suggesting such an innovation.

The proceedings then terminated with a conversazione, at which the following objects were exhibited :—

Transverse Section of Tail of Puppy ...	Mr. W. J. Brown.
Stained Pinnule of "*Polystichum angulare*"	Mr. Buffham.
Spicules of Sponge	Mr. A. C. Cole.
Lemon Parasite	Mr. A. C. Coxhead.
Ciniflo similis	Mr. F. Enock.
Section of stem of *Helianthus macrophyllum*	Mr. W. H. Gilburt.
Skin from a Cape Bulb	Mr. Glasspoole.
Jaw of Fœtus	Mr. J. J. Hunter.
Larvæ of Cat Flea	Mr. S. J. McIntire.
Porous Vessels in Beet-root, &c.	Mr. Martinelli.
Leg of Fly, with parasite	Q.M.C. Microscope.
Saw Fly—*Tenthredo variabilis*	„ „

Attendance—Members, 80; Visitors, 15.

December 14th, 1877.—Conversational Meeting.

The following objects were exhibited :—

Tobacco-leaf, showing the hairs and spiral tissue	Mr. F. W. Andrew.
Stained Blade of Maize, showing stomata...	Mr. T. H. Buffham.
Head of *Pulex adherens*, dissected by Mr. Tatem	Mr. T. Curties.
Eggs of Parasite of Pheasant	Mr. C. G. Dunning.
Pediculus Melitte (Parasite of Wild Bee) ...	Mr. F. Enock.
Melicerta ringens, surrounded with *Vorticella*	Rev. H. J. Fase.
Transverse section of *Taxus baccata*, double stained	Mr. W. H. Gilburt.
Foraminifera	Mr. H. F. Hailes.
Wing of House Cricket (polarized) ...	Mr. A. H. Halley.
Injected sections of Kitten	Mr. J. J. Hunter.
Injected sections of Guinea-pig	Mr. W. W. Jones.
Lenticular (?) images in areolar structure of *Triceratium septangulatum* ...	Dr. Matthews.
Obelia geniculata, with tentacles extended...	Mr. A. D. Michael.
Colorado Beetle	Mr. W. Moginie.

Euplectella, showing floral spicules *in situ*...	Mr. B. W. Priest.
Diatoms from Penang	Mr. F. Roper.
Podura scale with 1-10th immersion objective	Mr. J. Swift.

Mr. Ingpen gave an elementary description of the theory and construction of the microscope.

Attendance—Members, 66; Visitors, 10.

December 28th, 1877.—Ordinary Meeting.

Dr. J. Matthews, F.R.M.S., Vice-President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following gentlemen were balloted for and duly elected members of the Club :—Mr. J. A. Batchelor, Dr Thos. Partridge, Mr. Chas. Sands, and Mr. Thos. Wm. Watson.

Seven gentlemen were proposed for membership.

The following donations to the Club were announced :—

"The Monthly Microscopical Journal"—November and December ...	from the Publishers.
"Science Gossip"	,, ,,
"Proceedings of the Natural History Society of Glasgow" ...	,, Society.
"The American Journal of Microscopy"...	in Exchange.
"Annals of Natural History"	by purchase.
"Grevillea"	,,
"The Medical Examiner" (weekly) ...	from the Publisher.
"Reports of the Smithsonian Institution"...	,, Institution.
"The Analyst"	,, Publishers.
"Proceedings of the Belgian Microscopical Society"	,, Society.
"The American Naturalist"	in exchange.
"Proceedings of the Geologists' Association"	from the Association.
"Proceedings of the Watford Natural History Society"	,, Society.
"Catalogue of the Diatomaceæ," by Mr. F. Habirshaw, of New York ...	,, Author.
Six Slides	from Mr. T. H. Buffham.
Six ditto	,, Mr. T. Curties.
Six ditto	,, Mr. A. D. Michael.
One ditto	,, Mr. Moginie.
Six ditto	,, Mr. Tatem.

The thanks of the meeting were unanimously voted to the donors.

Mr A. Cottam read a paper "On the New Autographic Process," in which he fully described the *modus operandi*, and strongly recommended the adoption of the method as being much superior to lithography—as

ordinarily understood—for the reproduction of microscopical drawings. Specimens of the transfer paper, and numerous prints executed by the process, were exhibited in illustration of the subject, and were subsequently distributed amongst the members.

Mr. J. G. Waller had seen the working of the process, as a friend of his was in the habit of making all his drawings by it, and he could say from knowledge that it would be found to answer the purpose in every respect.

The Chairman said he could fully endorse the opinion of the reader of the paper as to the great desirability of an observer illustrating his own observations. Sir John Herschel used to say that an anatomical observation required not only a telescope and an object, but also an *eye*; and the paper they had just heard seemed to show that another thing was also necessary, namely, a *hand*.

Mr. Marcus M. Hartog read a paper "On the Investigation of Floral Development," in the course of which he described the best method of dissecting and examining the subjects under observation, and gave many valuable hints as to the most useful appliances for the purpose.

The Chairman, in proposing a vote of thanks to Mr. Hartog, expressed his sense of the value of the paper, which he thought was one of the kind they so urgently needed, as being a description of new and useful modes of investigation by simple means. He heartily commended the suggestions which Mr. Hartog had made to the attention of the members.

Mr. Gilburt said there was just one other "little dodge" which would be found extremely useful, because it enabled fresh sections to be mounted at once. Fresh sections of the "growing point" should be made and put into alcohol for about ten minutes, after which they could be put into oil of cloves and then into balsam. By this means the protoplasm was shrunk a little from the cell wall—which was an advantage—and they could take sections from the growing point to the extreme end, and preserve them directly, and much better than by using glycerine; the whole process could be gone through in half an hour, and they got the sections well preserved in what was practically their natural condition. Balsam in benzole should, however, be used, as it worked better and was more suited to the purpose.

Mr. Ingpen enquired if the lenses of the simple microscope recommended by Mr. Hartog were single lenses or achromatic combinations?

Mr. Hartog said they were not achromatic, but the form was a doublet which Chevalier had long adopted, consisting of two plano-convex lenses, with a diaphragm between; the lenses were of different sizes, the small one being at the top, and both having their plane sides towards the object.

Mr. Ingpen said this arrangement was the converse of the well-known "Wollaston doublet," which had the larger lens *above* the smaller one. This combination was new to him, and he was much struck with the size and flatness of the field it gave. The stand was certainly very well adapted for the purpose of dissecting.

The Chairman thought the stand was quite a model of firmness. He asked if Mr. Hartog found much difficulty in holding the object during dissection?

Mr. Hartog said that the manipulation was extremely difficult, and only to be attained by practice; he only held the object with one needle whilst he worked with the other.

Mr. Ingpen said he could corroborate what had been said as to the value of the lancet-shaped needles for purposes of dissection. They were difficult to get here of exactly the shape, and he generally had to get them ground from "eye-knives."

Mr. Hartog said he had been informed that it was possible to examine even a dried specimen by soaking it in water, and afterwards plunging it into alcohol.

The Chairman thought the question of holding objects during manipulation was one of very great importance. He had seen sections of fungi growing on a leaf, and could not imagine how such beautiful sections were produced—showing perfectly the shape of the cups. He should be glad if any one could tell him how they were made.

Mr. T. C. White said he had some little experience in insect dissection, and there were a great many small specimens which were not capable of being pinned down, and for holding which he had made a composition of Canada balsam and bee's wax, which held them perfectly, and did not dissolve under water. It seemed to him that perhaps this might be useful for the purpose of holding the vegetable specimens, and thus enabling the operator to use both hands freely.

The Chairman thought that a vegetable tissue would not be so firmly held in such a medium as was necessary.

The Chairman announced that at their next Gossip night Mr. T. C. White had undertaken to give a *viva voce* account of the mysteries of balsam mounting.

The proceedings then terminated with a conversazione, at which the following objects were exhibited:—

Mole Flea (eyeless)	Mr. F. W. Andrew.
Stained Filmy Fern (*Hymenophyllum Tunbridgense*)	Mr. T. H. Buffham.
Scaled Spider (from Ceylon)	Mr. Curties.
Rabbit Flea	Mr. F. Enock.
Mandibles of Scorpion	Mr. H. R. Gregory.
Kidney of Pig	Mr. J. J. Hunter.
Melicerta, *Stephanoceros*, &c. (from Hampstead)	Mr. Le Pelley.
Alpine Beetles (*Batrisus formicarius*) ...	Mr. R. T. Lewis.
Colorado Beetle	Mr. Moginie.
Hydoida sertularia	Mr. T. S. Morten.
Aulacodiscus anœnus (from Moron) ...	Mr. T. H. Powell.

Attendance—Members, 39; Visitors, 7.

On Glyciphagus palmifer.

By A. D. Michael, F.R.M.S.

(*Read 25th January*, 1878.)

Plate III.

During the Christmas time which has just passed I went for a visit of a few days to some friends living in a small agricultural village in Warwickshire, a few miles from Tamworth, and, the weather being too bad to venture out, it struck me that I might as well see what objects of microscopic interest I could find in the house ; with this view I descended into the beer cellar with a plate of glass and a camel's-hair brush, and gently brushed a small part of the wall on to the glass ; the result, on examining the sweepings, was that I found a good number of living specimens of *Glyciphagus palmifer*, and as this most beautiful and extraordinary mite has not hitherto been found in this country, as far as I can ascertain, I have thought that it might be of sufficient interest to exhibit to you to-night ; and I have been asked to describe it. Before doing so, however, I wish to say that the subject has been most admirably and exhaustively treated by MM. Robin and Fumose in " Robin's Journal pour l'Anatomie et Physiologie " for 1868, and those gentlemen have left little that is new for any one else to add ; the work, however, is difficult of access in this country. There is also a short notice of the species in Mr. Andrew Murray's late work on the Aptera, with a drawing very well copied from Robin and Fumose's figure by Mr. Whymper ; which drawing, however, being somewhat highly shaded, scarcely gives as correct an idea of this white and transparent creature as the original, more diagramatic, figure.

Mr. Murray anticipates in his article that as *G. palmifer* is found both in France and Germany, it may possibly also be found in the southern parts of this country if properly sought for. I do not, however, myself consider that the mite is finally established as indigenous here by my capture—in the first place because so very minute

a creature as this, particularly when inhabiting cellars and places whence goods are exported to foreign countries, is very easily carried with those goods, and very easily spread afterwards, when those, or other goods lying near them, are sent from one place to another; and this reason appears to me to render it always very difficult to say whether such creatures are indigenous or introduced; and in the next place, because, at the suggestion of Mr. Murray—whose loss we all of us, I am sure, deplore—I caused enquiries to be made, and ascertained that some three or four years ago my friends imported a cask of claret from Bordeaux, which was stored for a time in part of the cellars not very far from where I found my specimens: there are not any to be found now, either in the place where the cask was kept or on the cask itself, but they might have migrated to a more congenial place. After a day or two a thaw came on, and the cellar wall streamed with damp, I then failed to find any more; but I brought up some scrapings from the wall from which I have since bred several.

The genus *Glyciphagus* belongs to the true Acaridæ: it is characterised by a pointed rostrum with chelate (nipper-like) mandibles; a dorsal depression instead of a distinct transverse line between thorax and abdomen; a five-jointed leg, with the tarsus terminated by a small sucker and very small single claw; and particularly by three peculiarities, viz.:—1stly, the skin of the back being plicated to such an extent as to present a velvety appearance; 2ndly, the body in the females being terminated by a short projection, or anal button, as Murray calls it; and, 3rdly, the hairs or some of them being either plumose or developed into the remarkable leaf-like expansions which I am about to describe.

MM. Robin and Fumose divide the genus into two sections, the second section containing the present species, and being distinguished by the body being shorter, smaller, and less indented, the skin more wrinkled and velvety, and the hairs either very plumose, as in *G. plumiger*, or else developed in the remarkable manner which is observed in this species only; but before describing these I will pause for an instant to point out that this may be considered the culminating point of that series of hair developments which the mites present. In the first place we have the simple hair, as in *Tyroglyphus*, then in such a species as *Trombidium curtipes* we have the knobbed hair so well known in plants. Then, in *Pteroptus* and *Otonysus*, we have the imbricated hair like that of the bats, a fact which Mr. Murray justly remarks is very singular, since both of

these genera are parasitic on bats ; but the parasites of bats are not the only mites that have the imbricated hair, as I find it even more strongly marked on the hairs on the legs of some of the rarer *Cheyleti ;* then in *Glyciphagus* we have the plumose hair, either slightly so, as in *G. cursor* or *G. spinipes*, or almost forming a plume, as in *G. plumiger ;* and lastly we have the present species, which seems to show the transition of hairs into scales.

In *G. palmifer* the hairs along the edge of the body are developed into what Murray calls "pennate, transparent, spatulate plumes," which, however, I prefer to call leaf-like expansions. These stand out from the edge of the body and curve slightly downwards ; there is a thickened mid-rib, or, so to speak, a quill, from which lateral nervures run to the thickened margin of the leaf. These nervures sometimes go straight from the mid-rib to the margin, and sometimes divide into two or three before reaching it. The edge of the leaf is thickened, forming a rim all round, from the exterior of which spring a number of short, strong spines, not continuous with the nervures, but more numerous, and set at a different angle. There is also a double row of similar spines down the mid-rib diverging. The mid-rib is joined to the nervures and rim by a transparent membrane. Each hair is set in the usual way into a little projection or papilla of the body, the mid-rib only running in like a quill ; this I have seen best by polarised light, with a blue selenite, when the mid-rib—even that part within the body—assumes a brilliant metallic green, and is very conspicuous. The leaf-like hairs are very different in the male and female, those of the female being shorter and broader, and more leaf-like, than those of the male ; but there are two plumes not far from the anus in the female resembling those of the male. A drawing of one of the leaf-like hairs of the female, highly magnified, is given (fig. 3).

At each side of the back, a short way from the posterior margin, is a single leaf-like hair (in the female) which, in the male, is replaced by a very long plumose bristle, standing out transversely, and which Robin and Fumose draw as turning sharply round at a right angle about one-third of the distance from the tip, and Murray copies it thus ; in spite of the ability of Mr. Murray, from whom one differs with great hesitation, I have not liked to draw it so, as it has not been so in any of the numerous specimens which I have seen alive ; and it appears to me that Robin and Fumose did not intend it as a fact, the hair being bent conspicuously in order to get it into the plate, for which it would otherwise be too long. This

is not unusual with French draughtsmen. These hairs, both in the male and female, appear to form good sexual distinctions, as they are absent in the nymphs, which are devoid of sexual organs, but in other respects resemble the perfect creatures, both male and female.

The colour is clear, grayish white, the body is flattened and attenuated in front, but more so in the male than in the female, giving the former a more pear-shaped and the latter a squarer appearance. The transverse depression of the skin on the back is marked by a line of strong warts.

The males are smaller than the females. Robin and Fumose give the average sizes as follows :—Males, ·20 to ·25 mm. long ; ·14 to ·16 mm. broad. Female, ·30 to ·35 mm. long ; ·18 to ·22 mm. broad.

The legs are larger in the male ; the tarsi alike in both sexes —nearly as long as the width of the body ; the sucker is larger than in most species of the genus, the claw monodactyl, and extremely small.

The male organ is placed between the insertions of the third pair of legs, and does not reach the insertion of the second pair ; the vulva is placed between the insertions of the third and fourth pairs of legs, and is considerably enlarged posteriorly. During copulation the two remain in contact by the ends of the abdomen, and the female continues to walk dragging the male.

The anal appendage (to the females only) is a short truncated cone.

The palpi are cylindrical and three-jointed.

The larva is hexapod, about half the size of the imago, and devoid of the anal appendage and sexual hairs on the back.

The Nymph is octopod, larger than the larva, but is devoid of sexual organs, anal appendage, and sexual hairs on the back.

The egg is a long oval, depressed on one side.

The pace of the creature is slow, but the males walk faster than the females.

The species frequents the dust and walls of damp cellars.

DESCRIPTION OF PLATE III.

Fig. 1.—Male. Upper side, × 200, *a*, Sexual hairs.
Fig. 2.—Female. Under side, × 200. *a*, Anal projection; *b*, Vulva.
Fig. 3.—Leaf-like hair, × about 1,000.
Fig. 4.—Mandible, × about 1,000.
Fig. 5.—Tarsus and Claw, × about 1,000.

A Few Remarks on Insect Dissection.

By T. Charters White, M.R.C.S., F.R.M.S., &c.

(Read January 25, 1878.)

Perhaps no field of microscopical research teems with richer veins of interest and instruction than that upon which I have ventured to intrude this evening, but feeling so deeply interested in it myself I may be pardoned if, in the absence of others better qualified, I endeavour to throw out a few suggestions that will be of assistance to those amongst us, who, taking up the scattered clews of my short paper, may work them into a fabric of surpassing pleasure.

The lengthening days of early spring already invite our attention to the resurrection of animal and vegetable life, and, like good generals, preparing for a campaign, we should begin to lay our plans for future work during the coming year.

With the advent of our summer excursions many opportunities will be afforded us for leaving the busy throng, and exchanging its bustle for a few short contacts with nature in her loveliest aspects ; and while many of our members will find a revival of old delights in the capture of *Conochilus* and *Volvox*, there may be others who, like myself, see in their revolutions, beautiful as they are, only the same monotonous rolling as we have ever witnessed, and would rather behold something of that wondrous evolution manifested in the development of the various forms of insect life, so abundant in the early months of the year ; and which may be compared to simple experiments in biological science, ready-made to the hands of the diligent students who will take the trouble to look for them.

Of all anatomical studies, that which treats of the comparison of a particular organ in one animal, with its homologue in another, yields the most untiring pleasure to those engaged in them. The study of comparative anatomy is inexhaustible in its interest, and many amongst us would take it up but for a mistaken notion which prevails, and leads many to suppose that all studies having anatomy for their basis should, by reason of their nature, be relegated to the

region of the medical theatre and the dissecting-room, that none but "doctors," especially educated for such researches, are capable of mastering the difficulties of their details ; but that feeling is a mistake, and the sooner it is dissipated the sooner will the clear light and joy of a new field of investigation be opened up for your delectation.

With these few words of encouragement, I will proceed to say something relative to the practical carrying out of the subject under consideration.

Three things will be found necessary, viz., *magnifying power*, *good light*, and *instruments*, and we will treat of these in this order :—

All who have seen the dissections made by our friend and fellow member, Mr. W. T. Loy, must have admired the skill and neatness with which they were done, and could only regret that he had not in many more instances carried them on to the isolation of the separate organs of each insect, for no member seems to possess greater operative delicacy than he. By his kindness I had an opportunity of inspecting a very ingenious method of adapting his magnifying power to his work, which I should like to describe to you, although I have not his permission for so doing : it struck me by its simplicity, as well as by its efficacy, and therefore I trust I may be allowed to mention it without incurring the character of revealing any private affair. It consists of a heavy metal foot, into which an upright iron rod is fixed—round this rod is coiled one end of a stout wire, the other end of the wire being bent into a ring to hold a watchmaker's eye-glass; this arrangement, by pressing the head down, focusses the lens upon the work while both hands are at liberty, and when I tell you that all these beautiful dissections of his were accomplished by such a contrivance, it will be sufficiently recommended to your use, even if we leave out of consideration its comparative cheapness, compared with other optical arrangements.

The dissecting microscope I made for my own use some years ago is more complete than that I have just described, and would, if made by an instrument maker, be more expensive than that of Mr. Loy. It consists of a rod sliding within a tube, and made to stop at any elevation by a flat spring attached to it and pressing against the inside of the tube. The tube screws into a hole in the dissecting table, and the upper end of the rod is made small enough to be inserted into the hole in the handle of the ordinary three-glass pocket lens ; by this means each of the three lenses may be used as occasion

requires and brought to bear on the subject. The lower power microscopical objectives, such as the 1 inch, 1½ inch, and 2 inch, may also be used, being supported in such an arrangement as that first described, but far better results will be attained by the use of an erecting glass in the tube of your microscope, because that affords a ready method of varying your magnifying power and adapting it to the dimensions of the work under dissection, and rendering what would be otherwise very difficult a simple matter of steadiness of the hand.

Our next consideration must be in the direction of a good light, and this, with some dissectors, is so important that it occupies a priority over magnifying powers ; but, however much we may differ from them in this point, there cannot be a doubt about this operating as a most important factor if we would get good results ; and although a successful dissection may be made with a full light condensed on your work, yet better will be obtained by your light being supplemented by the magnifying power. The plan I have adopted for this is inexpensive and simple—a Florence oil flask is well cleansed and filled with water, then securely corked and waxed to prevent leakage. It is then supported longitudinally by a tube which grasps its neck, the tube itself being supported on an arm held on a heavy foot ; this gives the power of adjusting the focus of its rays upon your dissection to any extent you may deem desirable, while should a fracture of your flask occur it is easily and cheaply replaced.

The morning light is better than any other, the horizontal rays falling more agreeably on your work than the vertical rays from a lamp at night, and in the morning the hand is steadier for the work. An advantage is gained sometimes in dissecting by transmitted light, especially if you can impart a blue tone to it ; at other times greater advantage is attained by dissecting by reflected light, and on a black ground. As an aid, I would also recommend that your subject should be stained by carmine or logwood before dissecting.

The instruments necessary for insect dissection are not expensive, and may nearly all be prepared at home ; but one essentially useful is a pair of small spring scissors. These cannot be dispensed with, nor can a firm but fine pair of forceps, for before you can reach the internal organs of an insect it is necessary to remove the external chitinous integument, and in some cases this is so hard that in the case of the stag beetle a pair of wire nippers will not be too strong for this purpose. The cutting instruments, the scalpels, in fact,

may be formed out of needles set firmly in wooden handles. They may be of different widths and of various curves—such a needle ground flat and sharpened makes an excellent knife, while some of the needles may be blunt and slightly bent for the purpose of holding the different parts down while they are cut, or of separating the organs from the entangling mass of tracheæ, with which they are bound to the adjacent structures.

Another useful auxiliary will be found in the fluid under which you must always carry out your dissection, by increasing the density with glycerine, and varying it according to circumstances, it may be made to support and hold out of the way delicate structures that would be liable to injury or impede the progress of dissection during the operation.

The other implements necessary are a small square of entomological cork, loaded by insertion in a plate of sheet lead, to which your subject may be fixed. A glass trough, about 1 inch in depth, or even less for some cases, is better than any other I have tried.

Now I do not, in this short paper, pretend to give you anything more than the *modus operandi* I have found useful to myself. I know there are others here who may have further information to impart relative to their procedure, and to those these few remarks may serve as the text for the subsequent discussion.

In preparing an insect for dissection, if you intend to examine merely the internal organs, it is better to remove all the external organs as the legs, antennæ, &c., of course previously killing the insect with chloroform. Then the plan usually recommended is to pin the subject on the loaded cork, and place it in the trough under water. Now this plan is very well in some cases, but I prefer another, which I can recommend as being far more efficacious, and that is while your insect is dry drop upon the part you intend to fix it by, some melted wax and Canada balsam, the same composition that I have before recommended to be used as a cement for cells in dry mounting, only in this case you have to add a little more Canada balsam. You may then drop some more on your loaded cork and stick your subject on it. There is an advantage about this, which the simple pinning will not afford, and that is you may dissect your subject to the last piece without dragging it off the cork, which very often occurs through the pins on the subject giving way.

Now having fixed your subject, insert the point of your scissors between any of the abdominal segments at the junction of the tergal

with the sternal surfaces and carefully slit up the integument, repeat the process on the opposite side of the body, and then raise it by holding it with the forceps and clearing away its attachments with the needle, you will then not disturb any of the subjacent visceral organs, but will see them all *in situ*. Having noticed their relations one to the other, proceed to isolate them by clearing away all the tracheal attachments with two needles—a blunt one and a sharp one—and if done with a steady hand and a keen look out, no very great difficulty will be experienced in unravelling what before seemed a tangled labyrinth. It is sometimes a good plan after removing the integument from the sternal surface to place your subject in glycerine and water, and to leave it for 24 hours; but in this matter I would leave the matter to every man's own judgment, for sometimes I have found very good results arise from the simple dissection under plain water. We must bear in mind that we are working on tissues of great delicacy, and will do well to observe two precautions. Your instruments must be perfectly free from roughness, either arising from patches of rust or burrs left after sharpening. I have often experienced great annoyance after making a delicate dissection that has consumed perhaps a couple of hours, and have taken up a flattened needle to it, and not detected some roughened spot till it has caught some of the fine fibres of my work, and then all was a hopeless mass of entanglement. Again in dissecting out the nervous distribution in insects the nerves will be found very fragile, and will scarcely bear the strain put upon them in clearing them from the surrounding tissue; but the addition of a little alcohol to the fluid under which they are being dissected will harden them, and so prevent their rupture. This I have found a very useful agent in carrying out dissection; it comes in in all cases most advantageously, enabling you to isolate many organs, that without its aid would collapse and become, to coin a phrase, a mass of inextricability.

The medium I have generally found most suitable for mounting specimens of insect dissection in has been glycerine. Nothing has shown them up to greater advantage, and I should recommend that in preference to anything else, as it maintains their transparency, while other preservative fluids make them dense and discoloured.

With these few remarks I must close this short paper, hoping it may induce some one to take up this subject, and not only produce pleasure in themselves but also add to our knowledge in this interesting branch of biology.

On Some Microscopic Tracings of Lissajous' Curves.

By Robert G. West.

(*Read February 22nd*, 1878.)

In inviting your attention to the above subject, it is perhaps appropriate to give you some facts of the history of these curves, to offer some explanation of their nature, and of the various contrivances for producing them, and to endeavour to show something of what has been previously done in microscopic writing and ruling.

The earliest discovery of these curves of which I have been able to find any record, is that of Mr. Sang, of Edinburgh, made about forty years ago. Mr. Sang embodied his results in a contribution to the Edinburgh Philosophical Transactions, entitled "On the Vibration of an Elastic Spring." About two years afterwards Mr. Perigal followed in the same line with his "Kinematic Curves." In 1844 Professor Blackburn, of Glasgow, invented a form of pendulum capable of swinging in two planes, the curves produced by which were recorded by a fine stream of sand falling from the pendulum-bob, and were similar to those afterwards produced by Lissajous. In the "Annales de Chinicie et de Physique" for 1857, Lissajous contributed the results of his investigations, which had chiefly an acoustical bearing, and were conducted by means of mirrors attached to tuning-forks and reflecting a beam of light, so as to produce, by the persistence of the retinal impression, a continuous curve, characteristic in each case of a particular ratio of the fork-vibrations. In 1871 Mr. Hubert Airy was independently led to the discovery of these curves by observing the accidental gyrations of an acacia-shoot. Mr. Airy narrated his experiments in two very interesting papers in *Nature* for the 17th August and 7th September, 1871, and has given a lucid analysis of the figure produced by nearly coincident vibrations. I have made some experiments with the apparatus devised by Mr. Airy and Mr. Routh; but that described by Professor Swan, of the University of St. Andrew's, in a letter appearing in *Nature* for the 7th September, 1871, seems better, as

being free from the tendency to twist, and so alter the relative lengths of the pendulums ; also as eliminating any real or apparent effect of unequal lateral tension of the strings. I believe the next stage was Mr. Tisley's happy combination of the movements of two separate pendulums in a single point, as described by him to the British Association in 1873. Following this was an exact and scientific explanation of the curves by Dr. C. Giebel in the "Zeitschrift für die gesammten Naturwissenschaffen," Bd. xiv., October, 1875. In the "Loan Collection of Scientific Apparatus," in 1876, an instrument embodying some new features was sent by the Institute for Physical Science of the University of Halle ; and later, Mr. Browning has introduced a cheap form of the apparatus, which he calls the Sympalmograph, and has issued an interesting pamphlet in connection with it. There is also a description of Mr. Tisley's machine in "Engineering" for the 6th February, 1874, and he has since produced a cheaper form of it. I will proceed to describe briefly the Compound Pendulum Apparatus, by which these curves, in their ordinary form, are produced. Two pendulums are suspended so that their planes of vibration are at right angles to each other. From a point in each pendulum above the point of suspension there proceeds an arm, connected at one end with the pendulum by means of a ball-and-socket joint, the other extremities of these arms meeting in a glass tube-pen, which traces a line representing the resultant of the motions of the two pendulums. This is substantially the instrument as originally brought out by Mr. Tisley. In Mr. Browning's Sympalmograph, the details differ in several respects, chiefly in the connecting arms being attached by means of a Hook's universal joint *below* the points of suspension of the pendulums. If either pendulum is set vibrating separately, the pen will trace an arc of a circle, of which the radius will be the arm attached to the other pendulum, and the centre the point of that attachment. For the present let us consider these as straight lines. Now, suppose the pendulums adjusted to vibrate exactly in the same periods of time, or, as it is usually put, tuned to strict unison, and that they are started exactly together. It is clear that the pen will trace a diagonal line, the resultant of the rectilinear motions, and this line will be repeatedly retraced as the vibrations die away. The angular direction of this line will vary according to the relative amplitude of the vibrations of the two pendulums. Directly, however, you leave this simple set of conditions, by starting one pendulum

after the other, by making their times of vibration unequal, or by combining the two expedients, the result is more complicated. If two equal pendulums be started, the one half a vibration after the other, a circular spiral, and with any other fractional start an elliptical spiral, more or less oblong, will be produced ; thus the ratio of 1:2 (illustrative of the musical interval of the octave) gives, with a simultaneous start, an approximation to a parabolic curve ; with the half-vibration start, the figure 8. With the higher ratios (2:3, 3:4, 4:5, &c.), the effect of throwing the vibrations "out of tune," as it is called, so as to let one pendulum gain on the other, is to produce a more or less confused figure ; but, with the simple ratios of unison and 1:2, very curious and beautiful effects are thus obtained, resembling in some cases the markings of Diatoms. By a very *slight* discordance in the vibrations, however, "water-markings" are produced, which constitute the chief beauty of these curves. Similar "water-markings" are obtained by the superposition of figures as nearly similar as can be traced, and in both cases the explanation lies near the surface. With the unison made so discordant as 29:30, a very curious stereoscopic effect is produced, resembling a piece of network hanging in folds.

But with the apparatus which I have described, none of the figures are strictly symmetrical, all being resultants of two arcs and not of two straight lines. The distortion, however, may be largely reduced by lengthening proportionately the connecting arms. It was entirely obviated in the Halle apparatus referred to above, an instrument designed by Herr P. Schænemann, and made by Kleeman, of Halle, in which the tracing-point was actuated by one pendulum only, while a glass tablet, carrying the card, and suspended by an elaborate system of cords, was impelled by the other ; by varying the angular inclination of the vibrations, curious skew and scroll-like figures were produced. Beautiful spiral figures are also obtained by rotating the card by clock-work.

With the subject of microscopic ruling and writing, I cannot deal completely, owing to the scattered nature of its literature. The finest rulings, prior to 1851, which I have found recorded, are those of Fraunhofer's fixed net micrometer for the telescope, and Sir John Barton's rulings on steel, which were both at the rate of 10,000 to the inch. Impressions of the latter were taken in gelatine, to serve as micrometers. In 1851, Mr. De la Rue exhibited 10 groups of rulings varying from 11,261 to 56,306 to the inch. Mr. W. Chandler Roberts, of

the Royal Mint, has shown fine lines ruled on gold, rivalling the diamond in brilliancy of colour. At the International Exhibition of 1862, Mr. Lendy, Engraver to the Royal Mint at Turin, exhibited some specimens of reductions on silver and steel effected by a machine which would reproduce, on a scale of $\frac{1}{15}$th, designs varying in size from 7·87 inches to ·039 inch in diameter. As an instance, a coat of arms containing the letter R, surrounded by a Gothic frieze, was engraved on steel in a space ·013 inch in diameter. Mr. Webb also showed a reducing machine at the Exhibition of 1862. An account of Mr. Stanistreet's Micro-rulings on glass and steel, and of his instrument for producing them, will be found in the "Monthly Microscopical Journal" for 1871, Vol. vi., pp. 151, 274. In the "Monthly Microscopical Journal" for 1874, mention is made of a Lord's Prayer written by Mr. Webb in a space of $\frac{1}{294}$th inch × $\frac{1}{441}$th inch, these measurements being verified by Colonel Woodward. This, it was stated, could be easily read with a good $\frac{1}{2}$ inch objective and central light.

The only record of the scales of M. Froment, of Paris, that I have met with, names them as ruled to $\frac{1}{25000}$ inch. M. Froment was celebrated for his microscopic writing, the inspection of which it was that incited Mr. Peters to construct his machine, beautiful and celebrated both in itself and in its results. This machine was described by Mr. Farrants in the "Transactions of the Microscopical Society" for 1855 (Vol. III. N.S.). Its power of reduction could be varied at will as far as 6,000 times linearly. By its means the beautiful bicircloids of Mr. Perigal were produced in circles the $\frac{1}{50}$th inch in diameter. Among specimens of its performance may be mentioned the inscription of the Lord's Prayer (ending with "deliver us from evil") in a space $\frac{1}{356000}$th square inch. This is at the rate of over 22 Bibles to the inch. The machine, together with Ibbetson's Geometrical Chuck, was presented by Mr. Peters to the Royal Microscopical Society. A Lord's Prayer is mentioned by Mr. W. Webb, as in the possession of Mr. Frank Crisp, as being written at the rate of over 59 Bibles to the square inch. The average space covered by each letter of this marvellous specimen is said to be the $\frac{1}{2100000000}$th of a square inch.

We now come to the still more wonderful rulings of M. Nobert. With reference to these I would remark that in nothing that I have read about them have I seen mention made of any claim by M. Nobert to absolute uniformity among his various plates ; and I am

told by one of the leading opticians in London that, as a matter of fact, they are *not* uniform. If this be so, it would seem that there has been some waste of discussion upon them. If they *are* uniform, it is surprising that M. Nobert should not have published the authorised version of their various scales, which his machinery would enable him to supply. There are two papers on Nobert's plates which are of much interest, the latter from the mechanical, rather than the optical point of view; one by Mr. J. A. Brown, F.R.S., read before the Royal Society, and reported in No. 163 of its Proceedings, extracts from which paper are given in the "Monthly Microscopical Journal" for June, 1876; the other, a paper by Mr. Wm. A. Rogers, in the "Monthly Microscopical Journal" for August, 1876. Mr. Brown gives elaborate measurements taken from paper-photographs produced by Dr. E. Curtis. From these it would seem that in the 15th band the widths of the lines, and of the spaces between the lines are equal, viz., the $\frac{1}{179860}$th inch. Materially finer lines than these cannot, it is said, be drawn under M. Nobert's pressure without the graving-point sliding into the previous grooves. Mr. Rogers' estimate of the width of the lines in the 19th band is $\frac{1}{180000}$th inch, his own finest rulings being the $\frac{1}{160000}$th inch wide. Mr. Brown quotes the statement that lines $\frac{1}{160000}$th inch are visible with a power of 125, and countable with a power of 160 (the standard of comparison with the naked eye being taken at eight inches). Mr. Rogers gives the eye much greater power. He states that a single line, $\frac{1}{300000}$th inch wide, filled with plumbago, can be seen at seven inches from the unaided eye, or, if reflected from a silvered surface, at 11 inches. The former distance gives an angle of vision of 1″; the minimum angle being, according to Dr. Royston-Pigott, 6″, and, according to other writers, 1′ to 2′. Mr. Rogers places the limit of visibility beyond the $\frac{1}{400000}$th inch. He says that he despairs of ruling 100 consecutive lines with a less error, individual or accumulated, than the $\frac{1}{300000}$th inch, and puts the usual range of error in stage-micrometers at from $\frac{1}{20000}$th to $\frac{1}{100000}$th inch, which seems high, especially if referring to the thousandth divisions. He also speaks of a *grain* in polished crown glass which causes lines sometimes to become enlarged in width, and sometimes to become serrated at the edges—if 25,000 to 30,000 to the inch, at once; if of coarser ruling, after a time. In two instances the disruption occurred under his actual observation.

Such merit of fineness or delicacy as may attach to the tracings

I have made is largely due to the excellent diamond point for which I am indebted to the kindness of Messrs. R. and J. Beck. This very delicacy is, however, in some cases a drawback, as it increases the difficulty of obtaining an illumination, which will show the figures in a striking way. Some of the lines which I have obtained have been measured by Mr. Webb as 55,000 to the inch. I have cut a few specimens more deeply, and they undoubtedly "come out" better, and even brilliantly, but they are necessarily coarser in line, and more widely spaced. A point of interest with respect to these curves is their possible value as test-objects ; and Mr. Wenham, to whom my acknowledgments are due for many practical and valuable suggestions, tells me that some of of them are quite sufficiently closely ruled for this purpose, and he considers that the intersection of some of the lines, and the gradual approximation of others, gives them a value above that of parallel rulings. With reference to this, I may mention that in some of the figures every degree of sharpness of curve is obtainable, from a line returning almost upon itself, at an exceedingly acute angle, to curves so flat as to present in parts virtually the appearance of parallel straight lines. Another point is that, unlike diatom-markings, which, after abundant controversy, can hardly yet be said to be indubitably understood, the nature of all lines cut in glass may, up to a certain point, be said to be known. It seems clear, from the nature of the case, that they must be formed by some such V-shaped grooves as are illustrated in section, thus :—\/—\/—\/— though, whether, in traversing transversely such a series of ridges and furrows, the tracing-point descends into the furrows, I cannot positively say. From some appearances which I have observed, I am inclined to think that the point leaps from ridge to ridge ; but I believe the apparatus could be modified to produce with certainty a vertically waved line, if desirable. A curious feature in some figures is that though all the lines would seem to be in the same plane (except in so far as affected by the consideration just named), it sometimes happens that an alteration of focus is requisite to bring out the transverse lines. I should mention that, with one or two exceptions, each of the figures is a single continuous line from beginning to end. These exceptions consist of one figure super-imposed on another.

I have alluded to the difficulty of exhibiting these objects. They are almost drowned in the glare of direct transmitted light. For general effect Mr. Curties, who has devoted not a little time and

study to the problem of their illumination, has found nothing so good as a brilliant dark-ground illumination by a large spot-lens. The difficulty in this case is to get a sufficiency of light with a really black ground. For the exhibition of "water-markings," a unilateral oblique light is advantageous, and is, perhaps, best obtained, as suggested by Mr. I. C. Thompson, of Liverpool, by stopping out $\frac{1}{2}$ or $\frac{2}{3}$rds of the hollow cone of rays given by dark-ground illuminators, so as to secure a *crescent* of rays. Complete rotation of the object is necessary to obtain all the "water-markings" characteristic of the more complicated curves, and of superposed spirals. Good effects are sometimes to be obtained with reflected light, and many of the figures have a singularly solid or scroll-like appearance, which, though sufficiently striking under the monocular, is enhanced by the binocular microscope.

I have traced a few curves, at Mr. Wenham's suggestion, on polished steel. These to the naked eye, or under a low power, have a brilliant iridescent appearance, but are not remarkable when more highly magnified, as the best steel surfaces which I have been able to procure are far too rough for any effective work of this kind.

There is some difficulty in effectively mounting the glass-tracings. Dry-mounting is, of course, the only available method. Both dust and wiping have to be avoided ; while it is necessary to defer the actual covering till the cement-ring is so far hardened that no "damping" whatever can take place. Any condensation of vapour beads the cut lines, and, in the most searching way, brings into view defects of surface-polish, otherwise quite invisible even under a good dark-ground illumination.

In conclusion, I think I may claim for these tracings some special interest ; mechanically, as successful examples of minute diamond-graving under somewhat new conditions ; microscopically, as test-objects, and as affording studies in illumination and in certain paradoxical and deceptive appearances ; and æsthetically, as even surpassing in beauty and brilliancy, and especially in stereoscopic effect, the larger curves which are so well-known and so much admired.

On a New Micrometer.

By George J. Burch.

(*Communicated by Mr. T. Curties; Read March 22nd,* 1878.)

Plate IV.

It is not every Microscopist who can afford a thoroughly efficient Micrometer, and it is not always that the possessor of one can find time to use it.

A really good working Micrometer should bear the same relation to the microscope that the two-foot rule does to the carpenter's bench—it should be both cheap and handy.

The spider-line Micrometer costs quite half as much as a good many people lay out on their microscopes, and the cheaper eye-piece scales used in its stead are at best only adjusted for one particular power, while for all others they are about as handy as the carpenter's rule would be if its measurements had to be reduced to inches by a table, or by Rule of Three. The result is that nobody uses a Micrometer if he can help it, unless he has nothing else to do. What is wanted is a Micrometer that shall

1.—Cost but little ;
2.—Measure accurately with any power ;
3.—Read in decimals of an inch or millimetre, without any calculation ;
4.—Apply equally well with all kinds of illumination ;
5.—And take no more time to put on than the mere changing of an eye-piece.

To invent such a Micrometer is a problem which I have had before me ever since the summer of 1872, and I now submit to you an instrument which bids fair to solve it.

Noticing one day some scratches on the lamp glass, focussed by the achromatic condenser, it struck me that I might use the image of a *scale* on glass formed in the same way as a Micrometer.

I saw that I could easily adjust the size of this image to coincide

with the divisions on the stage micrometer, by altering the distance between scale and condenser. But this was a troublesome operation, until I fixed the scale in a tube sliding below the lens—and then the divisions had to be so much smaller, that with my appliances I could not get them accurate. And, besides, it was of no use with large objects or front light, so I gave it up. However, I showed the principle, in a rough way, at a meeting of the Quekett Microscopical Club, on October 25th, 1872, and was somewhat surprised, a few months later, to find, from the Paper on the "Aerial Stage-Micrometer," published in the "Monthly Microscopical Journal" of January, 1873, that Dr. Royston-Pigott had been working in the same direction.* Dr. Pigott's paper so completely detailed my principle that I determined to abandon it altogether, and seek "green fields and pastures new." So I looked into the theory of the various forms of Micrometer.

The early microscopists aimed at getting micrometer and object in the same plane, and so laid the object upon the scale itself, in the lower focus of the objective. The next step was to place a real scale, or spider lines, in the image at the focus of the eye-lens, that is to say, in the upper focus of the objective. Browning, in his spectroscope, employs the image of a scale in the same place. Then the Aerial Stage-Micrometer reversed the operation with an image of the scale in the plane of the object, formed in the light, before it entered the instrument. In the two foci of the objective all possible variations of real scale or optical image had been used. But every lens has its two conjugate foci. One focus of the eye-piece coincides with the upper one of the objective, the other remained. It is only a virtual focus, for its sign is negative. It had not been used, that I know of, except indirectly, for micrometry. I wanted a novelty, so I varied all the conditions, and determined to unite an image of the scale, with the image of the object, after it had left the eye-piece. At first I proposed to use the glass scale and lens of my aerial stage micrometer, with a diagonal tinted-reflector fixed above the eye-piece—like a camera lucida set backwards. But just then I had occasion to investigate for another purpose the theory of the apparent distance of the magnified object. I found that as the focus is altered so the plane of the image varies

* A micrometer identical with Dr. Pigott's "Aerial Stage-Micrometer" will be found described in "Goring and Pritchard's Micrographia," 1837, p. 51. (Ed. Q.M.C.J.)

from the nearest limit of distinct vision to infinite distance. Then why not dispense with the lens altogether, and compare the reflection of the scale itself with the object, adjusting its distance till the divisions on it coincide with those on the stage-micrometer? At first it seemed as if it would be hard to compare the reflection of a real scale with an optical image, but it soon proved otherwise. Just as in the camera lucida, you see the image of the object thrown on the paper, and may measure it upon a scale drawn there, so here you see the reflection of the scale in the field of the microscope, and may compare it with the object.

This, then, is the principle of the new Micrometer. Briefly, it is an inverse application of the camera lucida, coupled with the direct use of a scale, the graduations of which are adjusted to size by varying its distance from the eye-piece.

In its simplest form, which I prefer, the instrument consists of a cap, A, slipping over the eye-piece, and carrying an arm, B, on which slides a clip, C, to hold the scale, D. The reflexion of this scale is thrown into the eye by the diagonal glass, E, and compared with the object seen at the same time through the eye-piece, F. (Plate IV.)

It may be objected that this is a heavy side-strain for the tube. Practically, I have not found it so, but the stem may be brought parallel with the tube by using a second larger mirror of looking-glass as in the second figure, or, the whole thing may be made smaller by having a lens to form the image of the scale. But then the instrument loses its simplicity, and is not so easy to use.

The stem should be about 10 inches long, and should be made to unscrew. Then, as to the reflector, I find thin cover glass gives a double image. Sömmering's steel disc, the camera lucida, or Dr. Beale's neutral tint glass, answer equally well; but for some purposes I should give the preference to a piece of looking-glass with the amalgam scraped off in the centre. If silvered glass is used, a tiny drop of nitric acid from a capillary tube will eat the requisite hole very cleanly. In this case the second image is completely overpowered by the superior brilliancy of the reflection from the silvered surface.

The scale may be copied from any graduated rule—millimetres are a convenient size—the length of the stem giving plenty of latitude in this respect. It may be drawn on ivory or card. A barometer scale, with its vernier, answers admirably—there being so few divisions, the eye is not confused in counting them—and it is

very accurate. All but the scale itself should be blackened. For some very brightly lit objects a transparent scale is useful, while for very faint ones, or for front light, a white scale on a black ground, or lines engraved on a polished strip of German silver, and illuminated by oblique light, may be employed. This last is the best for star measurement with the telescope—the delicate silvery lines standing out with peculiar distinctness, and without interfering with faint stars.

Advantages of the New Micrometer.

It is easy to make. Any one who possesses a Beale's Neutral Tint Reflector may adapt the New Micrometer to it. To adjust the scale (which should be numbered with the figures reversed), so that it may read decimals of an inch or millimetre, &c., use a stage micrometer, set the instrument in position, and slide the scale along the stem nearer or further from the eye, as it may require, till on adjusting the focus so that the apparent distance of the two images may coincide, every 10th division on the scale shall cover the 1-100th or 1,000th of the stage micrometer, according to the power used. Then mark the position of the clip on the stem with a file. This position should be found for each objective with each eye-piece ; the higher the power, the more delicate is the measurement.

To the optician, the construction of this Micrometer offers no difficulties. There is no screw to make accurate in thread and in bearing—no microscopical scale to engrave. It is made in the way that is most convenient, and afterwards adjusted to the required standard.

It is easy to use. The Micrometer, with its scale clip set to the mark corresponding to the power employed, has only to be slipped on in place of the eye-piece cap, and the measurement made by inspection. If the object does not lie in the right direction, twist the clip on the stem, and the image of the scale will revolve in the field of the microscope, so that it can be set exactly across the object. If the light is too strong to permit the scale to be seen, the lamp may be shaded with one hand, while the stage and focussing is managed with the other. Then there is no calculation required. The stem may be marked to read fractions of an inch, a line, or a millimetre.

As regards accuracy, I do not pretend that it will supersede the Spider-line Micrometer. But as far as all scale micrometers are concerned, it is not inferior to any. For it will fill the field with

divisions as fine and as close as can be distinguished at ten inches, and no scale can do more. But it is hard to get an eye-piece Micrometer that reads exactly thousandths, and even then it is only with one power.

The Aerial Stage Micrometer, like this one, has an adjustible scale, but on account of the lens being used to produce the image, any error in the setting will make five or six times the difference that it would in mine—in which the error of measurement is the same fraction of the object that the error of setting is of the length of the stem used. The personal equation, too, is evidently eliminated if the microscopist himself adjusts the setting by an accurate stage micrometer. But its principal advantage is found in the number of uses to which it may be put. When the stem is unscrewed it leaves the camera lucida intact. The clip will carry a Goniometer —simply a black index, like a watch-hand, with parallel sides, revolved by a button from the back in a graduated semicircle—the diameter being drawn specially broad for distinctness. It is as easy of application to a hand-magnifier as it is to a microscope. I use it with my dissecting lens, and even with my diatom-finder—a Coddington, of 1-20th of an inch focus. For more than a year I have had one fitted to my small lathe, and have rejected the ordinary gauge in its favour. The metal seems to melt away under the tool by thousandths at a time, down to the required size on the scale. My experience of it is that it would be invaluable to the optician or watchmaker ; it reduces the chance of going too far, and saves a deal of time. Then with the Spectroscope it is quite as easy of application, and as comfortable to use as Browning's arrangement.

I have already mentioned the scale engraved on silver and illuminated by oblique light, as being best for astronomical use. It is specially adapted for star-spectra—a slight shading of the dark lantern reducing the brilliancy of the lines to any extent without impairing their distinctness.

Nor is this all. Not only can this Micrometer be applied to any and every kind of optical instrument, but it can be used by itself for many things that neither carpenter's rule nor callipers can reach. You have only to fit a rod ten inches long in place of the microscope tube, and set the scale ten inches from the reflector, and you may measure the size of anything in the plane of the end of the rod.

The internal diameter of a soda-water bottle—the contraction of the iris in a strong light—the diameter of a dew-drop—or the sweep

of a bee's wing as it hovers over a flower—in fact any of the thousand and one odd things that are commonly supposed to interest the man of science, may be determined by this simple arrangement. And I think it not unlikely that it may prove useful to the surgeon, in conjunction with the laryngoscope, as a guide in preparing for an operation.

During the four or five years that I have had it in use I have found it so handy and useful that I determined to show it to Mr. Curties, and ask his opinion. He at once gave a favourable judgment—kindly offered me every assistance and encouragement—(for which I heartily thank him)—and has undertaken, not only to read this paper before you, but also to provide one of the new Micrometers for presentation to your Society.

I am aware that the very simplicity of this instrument is prejudicial to it at first sight. There is no mystery of tubes and lenses about it to give it dignity. It looks make-shift rather than scientific. But a little thought will show that it is correct in theory, and a little experience with it will reconcile all who value time and money to its appearance. And I doubt not that, in abler hands than mine, the new principle that it involves will lead to useful, and perhaps more important results.

On a Method of Mounting Whole Insects Without Pressure for the Binocular Microscope.

By Staniforth Green.

(*Communicated by Mr. T. Curties; Read March* 22, 1878.)

Minute Hymenoptera (Ichneumonidæ, Chalcididæ, Proctotrupidæ, &c.), require little manipulation to render them fit for mounting in Canada balsam, and they are easily collected. I have captured numerous species in Ceylon by sweeping the grass with a small bag net, about 3in. in diameter at mouth, and tapering down to a point at bottom. It should be made of fine cambric, as many of these small insects do not exceed the $\frac{1}{64}$ of an inch in length. About a dessert-spoonful of spirit of turpentine should be placed in an ordinary wine glass, over which the net is to be drawn after a sweeping operation. While this is being done, the captured insects must be confined to the bottom of the net by gathering the net between the thumb and finger at about one inch from its bottom. When it has been drawn over the glass as far as it will go, then the thumb and finger must be removed, and the insects allowed to fall into the turpentine. They will quickly die, mostly with outspread wings and legs. Minute species should be fit for mounting after they have remained in turpentine for a few days. This treatment, however, will not succeed with more horny kinds, which, when thrown into turpentine or spirits of wine, curl themselves up in dying, and cannot afterwards be straightened out. Insects of that class should be placed alive on a piece of glass, and while walking, a thin covering glass can be let down upon them. Strong spirits of wine must be quickly introduced between the two glasses by means of a camel's-hair brush. This soon kills the insect in the position of walking, and it should be kept so in spirits for at least six hours. I use the ordinary 3 × 1 inch slip and a good sized covering glass—the heavier the better. Seven or eight specimens can be so arranged on one slide, which may be placed in a saucer containing sufficient spirits of wine just to cover them. They can afterwards be transferred to turpentine to render them fit for mounting in Canada balsam.

Dipterous insects of moderate size may be treated in the following way :—Catch them alive and hold their wings between the thumb and finger. Thus secured they should be dipped in turpentine, and held in it until quite dead. When released they will be found with elevated wings and folded legs. Let them remain undisturbed in the turpentine for five minutes or so. Then take them out and hold them by the wings while you arrange their legs under a magnifier, using a needle or a pair of fine forceps with a light hand, as legs come easily off. Replace them in the turpentine for a few minutes, and then transfer them to a small glass test tube one-third full of turpentine. Hold the tube over a spirit lamp till the turpentine commences to boil. Then examine with a magnifier the insects in the tube. If cooked enough, tongues will be found protruding from their mouths, forced out by the action of the hot turpentine. The ovipositors of female insects are also similarly displayed. This process much hastens the preparation of insects destined to be mounted in Canada balsam, but they must not be overcooked, as with prolonged boiling they are rendered too brittle and transparent. After removal from hot turpentine they should remain in cold turpentine until they become tolerably transparent, with a perfectly clean outline.

Spiders should not be boiled in turpentine. Kill them in spirits of wine, and then place them on a piece of glass,* and arrange their legs and antennæ in proper position, or as near as possible. Then wind a piece of fine sewing silk or thread round the glass in a way to keep the legs in the position they have been placed. When the winding has been completed, twist the ends of the thread together to keep them fast. Then place the piece of glass with the spiders on it in turpentine, and let it there remain until the spider becomes sufficiently transparent. I have sometimes first placed the bound spider in spirits of wine for a few days, and afterwards in turpentine, to render it more quickly transparent.

In my opinion the advantages gained by preparing insects in the way I have described are that they do not alter in figure, or very little so ; that their muscular structure is well shown, their eyes, tongues and ovipositors nicely displayed, and preparation easy of management after a little experience.

* I usually cut suitable pieces from rejected slips.

On Variation in Spongilla fluviatilis.

By J. G. Waller.

(Read April 26th, 1878.)

Plate V.

On a former occasion, I gave the result of some observations on the two British freshwater sponges. My present remarks will be confined to *Spongilla fluviatilis*. Dr. Bowerbank, in his admirable work on the British Spongiadæ, the result of a long life of research, makes the form of the spicule of the skeleton, membranes, &c., one of the distinctions of species. It is not only convenient, but, as an important part of the anatomy, a necessary item in the task of classification. But a question arises to what extent this is to be used: for the tendency to multiply species, though it has long obtained amongst naturalists, presents a formidable barrier to the student, in the large increase of terminologies, which, in their varied combinations, seldom convey any idea to the mind. It is, however, with some diffidence that I enter into so important a subject, and it is not by any means to disparage the many eminent men, who have done so much to advance our knowledge of natural history. But I feel it is forced upon me, either to protest against the excess of this practice, or to follow it myself. The latter I cannot do until the question is settled, whether it may not be as easy to combine under the title of "variation," instead of making a divergence under the name of "species."

In the third volume of the "British Spongiadæ" Dr. Bowerbank has introduced us to two new species of native Spongillæ. Both were found in the river Exe, or reservoir in connection with it, by Mr. Edw. Parfitt, of Exeter. One of these he has named *S. sceptrifera*, on account of its membranes having a small spicule, suggesting the sceptre-form character. One specimen of this only having been found, and that without the ovaria, which usually distinguish the Spongilla, our knowledge of it is at present limited. But the other nearly resembles, in all its characters, usual specimens

of *S. fluviatilis*, yet it differs from that which is described by Dr. Bowerbank, as typical of the species, in some minute particulars, to which I shall particularly direct your attention.

The specimen described as the typical *Spongilla fluviatilis*, was found in the West Country Timber Dock, at Rotherhithe, and its characters are thus tabulated :—

Sponge massive, sessile ; surface uneven, often lobular, hispid. Oscula simple, large, scattered. Pores conspicuous ; dermal membrane pellucid, aspiculous. Skeleton ; spicula acerate ; ovaria subglobose ; spicula birotulate, short, rarely spinous ; disposed in lines radiating from the centre of the ovarium ; rotula equal in size, flat, deeply and irregularly dentate, diameter equal to the length of the shaft of the spiculum.

Now the difference between this description and of that of the river Exe, is, that the skeleton spicules of the latter are of two kinds—one smooth as before, the other "incipiently spinous"—both irregularly mixed in the skeleton, but the latter fewer in number. The spicules of the ovaria are, more or less, spinous ; spines long and acutely terminated. Mr. Parfitt, in a letter to Dr. Bowerbank, stated that he considered the species as intermediate between *S. fluviatilis* and *S. Meyeni* of the Bombay tanks. Mr. Carter, describing it in the "Annals and Mag. Nat. Hist." April, 1868, calls it *S. Meyeni*, var. *Parfitti*. His description is fuller than that of Dr. Bowerbank, and I shall refer to it again. He appends the following observations : "This Spongilla chiefly differs from *Sp. Meyeni*, of Bombay, in the decidedly spinous character of one-third of its largest spicules, while about the same proportion in the Bombay species can only be termed 'incipiently spinous.' The excess of size of the elementary parts generally of the Bombay species over those of the variety in the river Exe amounts to nothing specifically considered."

"But there is a much more decided difference between var. *Parfitti* and the birotulate English species *Sp. fluviatilis*, which also grows in the river Exe, inasmuch as the spicules of the skeleton of the latter are *all* smooth, the shaft of the birotules somewhat constricted in the centre, approaching to the hour-glass shape, with the margin *only* of the rotules minutely dentate, almost fringed."

Now, it is necessary to observe, that the claim of the Spongilla of the Exe to be a new species allied to that of *S. Meyeni* is pointed out to be the spinous condition of a portion of its spicules, but it is

the last which has what may be truly called spicules "incipiently spinous;" for this character can only be discovered by the use of a $\frac{1}{4}$th objective.

Upon this, Dr. Bowerbank observes "How this British Spongilla can be a variety of a species that does not exist in England, or to the best of my knowledge nearer than Bombay, is quite past my comprehension; and I have, therefore, described it as a distinct species, under the title of *S. Parfitti*."

Before we consider the value of these differences, let me direct your attention to specimens found in the Thames, all of which differ from the described type, and some in their minute structure seem to be identical with that found in the river Exe. Neither Dr. Bowerbank nor Mr. Carter can have been acquainted with the Spongilla of the Thames, or they could not have avoided noticing the interesting variations from the established type. Indeed, almost all the characters set down are found to vary. First, as to the dermal membrane, which is pronounced to be without spicules, I can show you a specimen in which this organ is completely covered with spicules, matted together. Then, as regards those of the skeleton, examples are met with in which a portion of them take the "incipiently spinous" condition of that found in the Exe, and others pass from that into a greater development, so that more than one half of the spicules of the skeleton are spinous, and the spines well pronounced, until we reach the climax in which all are spined, with only here and there a representative of the smooth type-form. Passing from the Thames, out of which, as yet, I have not obtained a single specimen of the so-called type, I shall show you an example in which, though the spicules are smooth, yet both dermal and interstitial membranes are thickly provided with them of a slender, delicate and special character.

It will then be a question to ask whether, following precedent, we are to establish three or more species; or, whether it is not more in the interest of science to take a different course, and to endeavour to embrace, under the general title of *Spongilla fluviatilis*, all those which possess characteristics typical of the species; and especially in the birotulate forms of the spicules of the ovaria, noting, if you please, the varieties by either an additional name, or what would equally satisfy, in my opinion, all that is required, an addition of A, B, or C, &c. Surely it must be rather misleading than otherwise to have such a title as "*Spongilla Meyeni*, var. *Parfitti*," or even

S. Parfitti alone, applied to a slight variation. But if we retained "*fluviatilis*" we should naturally infer, whatever additions we gave, that it recorded a variation only from the known type ; and it may be that these observations might be extended even to some of the exotic species, for the multiplication of terms is in itself an evil, threatening to make us little better than walking catalogues.

Now the first of the Thames *S. fluviatilis* to which I shall call your attention is that found in Teddington Lock, because this comes as near as possible to that from the Exe, to which I have referred. In external appearance it partakes of the foliate or lobate form of one of the examples engraved by Dr. Bowerbank, Vol. iii, p. 295, fig. 7, but this is very common to the genus. The spicules of the skeleton are chiefly of the ordinary smooth type, acerate ; but among these is a variation almost cylindrical, the terminations being acutely pointed, making the whole not unlike a lead pencil, sharpened at each end. It is not, however, common only to this, as it occurs, though in a less degree, in most of the species. The rest of the spicules, perhaps about one-third, are spinous, like that of the Exe, sometimes slightly so, but some have the spines well developed. It is an interesting fact to which I must specially direct your attention that the growing fibres of the apices of the sponge have all the spicules smooth, and it is only as we proceed downward towards the base and older parts that the spinous character is produced. This in itself gives us a clear hint that the latter belong to a development which other examples, soon to be described, have carried still further. An abnormal form, which has often been found in the species, I have only found here. It is a spicule, somewhat symmetrical, having a central inflation, often two, and even three, and found dispersed throughout the tissues. I record it merely as a form, in which the Spongilla sports, not as having any specific value. As regards the birotulate spicules they accord with that from the Exe, being exactly the same size, viz., $\frac{1}{2000}$ of an inch, but I have not found the shaft so frequently spined. (Pl. V., fig. 1.)

Leaving Teddington Lock, we will proceed to that of Molesey, near Hampton Court, where this Spongilla grows in luxuriant abundance. Nowhere else have I seen such fine specimens. Here I have never seen the foliate condition, for the maturely developed sponge has a generally even surface, undulating slightly, but showing no differences from that which is typical. It is when its structure is examined under the microscope that its interest begins. Rising

as it does from the broad base of the lining boarding of the Lock, its growth is regular and symmetrical, as shown in its network. In a vertical section this is well demonstrated, and we find that nearly all the spicules thus seen are spinous, the spines being well developed. But if we get a horizontal section this is somewhat reversed, and the smooth spicule is then predominant; and when we give a closer examination into these constituent elements, it is found that there is about an equal division as regards numbers, and that half the spicules are spinous, and half smooth; the latter generally a little longer. As regards the birotulate spicule of the ovarium, it is in all respects similar to that of Teddington (fig. 2).

Let us now retrace our steps, and row back through that pretty part of our beautiful river, from Hampton to Surbiton; a trip at all times enjoyable, not even wanting the good excuse of the naturalist. Here, by the little eylet occupied by Messenger's Boat-house, &c., both our native Spongillæ are found in abundance. They grow on the moored barge-house, beneath the floating baths, and all round the wharf-boarding, in various stages of development. But the specimen to which I draw attention was attached to the floating barge, on the side towards the island, between which and it was but a small interval shaded from light. And, close by its side also grew *S. lacustris*, overlapping it in places; and so much alike, in every external character, that, without a lens, no distinction could be made between them; the branching form of the latter being wanting. It was a rebuke to naturalists in its name, so untrue as the Lake Spongilla, when flourishing under precisely the same conditions as *S. fluviatilis*, but also assuming its shape; showing, that their law, at least, must not be like that of the Medes and Persians, which altereth not.

The first point which close observation brings to notice, is, that the hispid character, which generally marks this Spongilla, was wanting; but, in place, was a felting of spicules on the dermal surface. It is a condition not hitherto observed. More intimate knowledge obtained by sections and close examination of the spicules reveal the fact of a still greater development of the spinous character, as the smooth type has all but vanished, leaving only here and there a representative. As regards the birotulate form there is no change, as it conforms to the two last (fig. 3).

So, here then, we have travelled the circle; beginning with the smooth spicule of the type, we end by finding it yield place to the

spinous one, and become practically obsolete. Place the two extremes side by side and the divergence is great ; follow the development through the Teddington and Molesey examples, and the connection is clear enough. Nor are the localities cited the sole places on the Thames in which these varieties are found. At Cleeve, in Oxfordshire, is a parallel to that of Molesey ; whilst at Goring, in the same county, we get that of Surbiton. But, as yet, the Thames has not furnished me with a single example coinciding with Dr. Bowerbank's type found in the West Country Timber Dock, and that locality has failed to give me a specimen. But the river, nevertheless, has given one with the smooth spicule only, but it provokes us, by not adhering to the type ; so even now we do not get rid of variation. This is a parasitic form, found at Henley ; not, however, in the full flow of the river, but in a small side creek ; a difference of condition which should always be noted, although at present we may not be able to draw conclusions from it. Here we find the dermal membrane completely matted with a dense mass of spicules, to a degree not often seen in the Spongiadæ at all—still less in a sponge in which its absence is declared to be a typical character. Noting that the shaft of the birotule is longer than those described, and I need not further detain you on this form, which concludes our Thames Spongillæ.

I have not, however, done with varieties ; for, having spoken of the parasitic form at Henley, I am now about to introduce to you another, which, in many respects, exceeds the rest in interest. This was discovered in a large pond, or lake, of two acres in extent, at Ditchleys, in Essex, growing upon the stems of aquatic plants at the bottom. The structure of a sponge will often depend on the base upon which it grows—certainly this is the case with the class to which the Spongilla naturally belongs. So one having a broad base will have its network regular and symmetrical ; whilst another, completely like it in other respects, but springing from a narrow axis, will appear very irregular. This is particularly seen in the example under consideration, its surface is flexuous and plumose. But, here, as in all other cases, the interest consists in a more intimate examination. In this, the spicules are all smooth, and, in all the parasitic forms, this seems to be the case ; but here, not only is the dermal membrane thickly furnished with spicules, but the interstitual membranes also have them ; they are of a more delicate character than the skeleton, though

of the same general type. So here is another variation which has not yet appeared, for, though allying itself with that of Henley, it has still its distinction from it. The membranes are more developed and require the sustaining spicula thus provided ; but it would not be difficult to show, in other examples, a step in this direction. But the most interesting fact in connection with it is the occurrence not only of the ovaria, so well known, which are to be seen here in every stage of progress, but also of that form, which occurs so often in the silicious sponges as the reproductive organ, generally termed the gemmule.* This is the first time that I ever saw or heard of this as occurring in the freshwater sponge, and it is often found in close proximity to the ovaria. The fact, however, is suggestive of the necessity of further research into the real part these organs play in the life economy. The birotulate spicule is very long in the shaft, thus bearing analogy with that at Henley (fig. 4).

A sponge found at Hertford, of which mere fragments came to my hand through our friend, Mr. Priest, to whom I have been much indebted for specimens, appears to be of the same character as that from Ditchleys, especially as regards the occurrence of the gemmule, but it appears to want the delicate spicules of the membranes ; my specimens, however, are not sufficiently good for me to determine this with precision.

I have now, then, gone through the varieties, but in my search for the typical Spongilla I applied to Mr. Fullagar, of Canterbury, a gentleman well known to us, as a correspondent, and to whose courtesy I am indebted for a specimen which he procured at Bolton Mills Pool, near that city. Being always particular as to the locality and to the conditions under which an object of natural history is found, Mr. Fullagar communicated to me, in answer to enquiry, that it grew "on the bars of the grating, which is placed in front, to prevent the weeds, &c., from going to the water-wheel.

* When naturalists have not yet determined the exact offices of the several organisms, it is difficult to distinguish them by a name. Gemmule, seed-like vessel, spore-case, ovarium, have all been given to the well-known forms connected with reproduction in the Spongillæ. I have used Dr. Bowerbank's term, which he adopted, as against the gemmule ordinarily found. To this latter Mr. Carter would apply the term ovisac ; more accurate, probably, for it is certainly no gemmule in the true sense of the term. But "ovisac" and "ovarium" are synonymous, and we cannot use both. In using here the term "gemmule" it will only be for the distinction of one object from another, not as assenting to the propriety of this term, any more than some naturalists do to that of "ovarium" given to the seed-like vessel.

There is always a tolerably quick current passing through." Now this statement has some value, as Mr. Carter, in his article on the Spongilla of the Exe, has hinted an opinion that the agitation of the water might be a cause for the spinous condition of the spicule. I must confess this was an idea also of mine, and I was watching to see if this rule could be borne out. Obviously it cannot, for a mill-stream is always agitated, and must be always strong in the vicinity of the wheel. So as this specimen conforms to the type *Sp. fluviatilis* in general character, and having but the smooth spicule, under such conditions we are not yet in a position to declare the law which operates to produce the changes alluded to.

Of all the examples of the freshwater sponge I have ever received, this was the richest in sarcode. It was the very alderman of sponges, fat to a degree, evidently enjoying life, and in full possession of that by which life is sustained. The constant flow of the mill-stream suited its constitution. Laying it out to dry in a summer's day, the olfactory nerves soon became unpleasantly admonished. I observed the blow-fly paying it assiduous attention, and in a few days it was as full of maggots as a dead dog festering in a ditch. The larvæ were of two kinds—one a very common form, the other having numerous feet, and the sponge was also full of eggs. Such a phenomenon I had never seen before, and if there now could be a doubt on the animality of the sponge, this fact may come into the argument.

It abounded in ovaria, often packed closely together, even in this declaring its pre-eminence. The birotulate spicules, however, were long in the shaft ; in this not conforming to the type whose exact character seems to elude my enquiry. (Fig. 5.)

It is time now to generalize and draw deductions suggested by the foregoing observations. I think I have sufficiently shown that *Sp. fluviatilis* is subject to considerable variation, consequent upon some law as yet unknown to us. But, from the easy manner in which the changes seem to pass through a series of gradations to a complete development of parts, I cannot but feel it contrary, not only to the interests of science, but to the facts arrayed before you, to declare any one of these a new species. The differences between the two extremes are certainly remarkable when they are brought together, and require some classification, but surely we should not want to travel to the Bombay tanks to find a name for a sponge found in an English river ; still less to baptize it with the name of a German naturalist, and that of its discoverer tacked on.

It must have been the vicious course of custom—

> "That monster custom, who all sense doth eat
> Of habits devil,"

That could conduct one of our ablest naturalists to such a decision. The *Spongilla* of the Exe is identical in character with that of Teddington ; that of Molesey and Surbiton also conform to the same, but are more completely developed ; it is therefore impossible to allow it as a species. It is indeed a very elastic argument that allies it to *Sp. Meyeni* on the strength of the very slightly developed spination of the spicule, and Mr. Carter does not admit the larger size of the latter as having any specific value, in which opinion I cordially agree. But it is as easy to take a reverse view, and say that *S. Meyeni* is allied to *Sp. fluviatilis*, and only a variety from it, and a far more natural conclusion. In fact, it is clear that this Spongilla may be divided into two natural divisions : one having the spicule smooth, the other spinous. Calling the first by its simple title, and the latter variety, in all its developments, with the addition of "*spinosa*," or "*spinifera*," and the demands of science would surely be better met. And, as regards the other variations, which I have noticed in both, the letters A, B, C, &c., would serve every purpose. Even in doing this one must not forget that the Teddington sponge gives us evidence of the spination being but a development from the smooth spicule, so that the idea of a new species, instead of a variety, is out of the question on that evidence alone. The main point in the classification I would propose, is to retain as a general term *Sp. fluviatilis*, for we may call that a known quantity whilst those of *Meyeni* and *Parfitti* are unknown. Before we can understand them we must go back to the details of our typical forms familiar in books on microscopy, if not from actual examples in our cabinets. The specific terms *fluviatilis* and *lacustris* might easily be improved upon, but the names are widely established. *Sp. birotalis* for the one, and *Sp. ramosa* for the other—the latter being indeed its old name would be more expressive of their characteristics, and would help us to class the numerous variations, British and foreign, better together. But I am indifferent on that point, so that we can avoid making unnecessary species. Against this we ought to make a stand. Natural history is no longer a study confined to a few of scientific leisure : it is now the healthful mental recreation of a large number of the community, embracing those

engaged in every department of life. It is therefore the more necessary that obstacles to the study of a particular branch should not be raised up by the creation of unmeaning names and complicated terminologies.

Description of Plate V.

The following figures of the spicules from the several specimens of the *Spongilla Fluviatilis* all drawn to the same scale, excepting the birotulate forms (40 diam.), for the sake of easy comparison, illustrate the argument of variation as against separation into species. Fig. 1 is a group from the Teddington Lock example. Fig. 2, Molesey. Fig. 3, Surbiton. Fig. 4 is a group from that of Ditchleys, the finer and more slender spicules being from the membranes. Fig. 5, from Bolton Mills Pool, Canterbury, gives the single form of acerate spicule, which characterises the species, and is remarkable for its large size, exceeding that of *Sp. Meyeni*, which is given in fig. 6, and which but slightly exceeds that of the longest from Ditchleys. The variation from the simple acerate to the fusiform, is here also shown, as well as that of size, which differs in every example; those of Molesey being the smallest, the spinous one from Teddington excepted. As to the birotulate spicules, they are drawn simply as they exhibit themselves under the same magnification (440 diam) and plane, as they vary much in appearance according to focussing. But the general character is obviously the same throughout, and if they differ from those published hitherto, as regards the flat face of the rotule, it will be a question as to how far imagination has not assisted in a rather difficult task, and led draughtsmen into seeing too much. The dentate edges differ in plane, and consequently differ according as they are focussed. The figures given are such as the several examples have exhibited when the front of the rotule is shown; and between them all, including even *Spongilla Meyeni*, there is no difference except in size. In figs. 1, 2, 3, the size is precisely the same, and agrees with *Sp. Parfitti*. The irregularly dentate character generally prevails, but the deep, neat, and more regular dentation given to that of Teddington, is but an instance due to focussing, and can be seen in the two following examples. The large size of the birotule of *Sp. Meyeni*, in its long diameter, exceeds all others, but it fluctuates into smaller forms, some of which are less than that of Bolton Mills Pool, whilst the diameter of the rotule is nearly of the same size, and the birotule of Ditchleys stands as intermediate between the less and the larger, and is paralleled by that of Henley. The dentation is sometimes strongly pronounced, and in others feebly out of examples from the same sponge, and varies much in detail, preserving, however, the same general characteristics. Fig. 7 is the gemmule (?) or ovisac found in the Ditchley and Hertford *Spongilla* (125 diam.)

PROCEEDINGS.

January 11th, 1878.—Conversational Meeting.

The following objects were exhibited:—

Hypersthene	Mr. F. W. Andrew.
Pinnule of *Nephrolepis auberosa*	Mr. T. H. Buffham.
Moss copper, &c.	Mr. F. Coles.
Hairs of *Croton elutheria*	Mr. T. Curties.
Tetanocera aratoria; Marsh fly	Mr. F. Enock.
Leaf of *Salisburia adiantifolia*	Mr. W. H. Gilburt.
Dendrospongia Steerii	Mr. G. Green.
Tourmaline Rock, showing dichroism ...	Mr. M. Hawkins Johnson.
Section of testicle of kitten ...	Mr. J. Locke.
Protococcus	Mr. A. Martinelli.
Plumularia setacea	Mr. A. D. Michael.
Spicules of *Lataria hemispheria*	Mr. W. Moginie.
Halyphysema Tumanowiczii	Mr. B. W. Priest.
Eucratia chelata	Q.M.C. Microscope.
Section of Oolite	Mr. W. S. Smith.
Platino-cyanide of Magnesium	Mr. J. Woollett.

Mr. T. Charters White gave a very full description of the best methods of mounting in Canada balsam.

Attendance—Members, 63; Visitors, 11.

January 25th, 1878.—Ordinary Meeting.

Henry Lee, Esq., F.L.S., &c., President, *in the Chair.*

The minutes of the preceding meeting were read and confirmed.

The following gentlemen were balloted for and duly elected members of the Club: Mr. John Allinson, Mr. George H. Beaman, Mr. David Bogue, Mr. D. H. Harrison, Mr. H. B. Lindsay, Mr. R. A. Potts, and Mr. Robert Yates.

The following donations to the Club were announced:—

"The Popular Science Review"	from the Publisher.
"Science Gossip"	„ „
"Proceedings of the Royal Society, No. 184	„ Society.
"Proceedings of the Bristol Natural History Society"	„ „

"Proceedings of the Botanical Society of Glasgow"	from the Society.
"Proceedings of the Belgian Microscopical Society"	" "
"Proceedings of the Royal Society of New South Wales"	" "
"The American Naturalist"	in exchange.
"The American Journal of Microscopy" ...	" "
"The Quarterly Journal of Microscopical Science"	by purchase.
"The Analyst"	From the Publisher.
Ehrenberg's "Deep Sea Foraminifera and Polycystina"	by purchase.
"The Medical Examiner" (weekly)	From the Publisher.
Say's "American Entomology"	" Mr. Lee.
Specimens of Diatomaceous Earth from Yarra River...	" Rev. J. J. Halley, of Williamstown.
1 Slide...	" Mr. Priest.
1 Slide...	" Mr. H. R. Gregory.

Photographs for the album from Mr. Wm. Atkinson and Mr. E. T. Newton.

The thanks of the meeting were unanimously voted to the donors.

Mr. Ingpen called attention to a new shade for a microscope lamp, exhibited by Mr Swift, consisting of an earthenware cylinder surrounding the glass chimney, and having a flap shade over the aperture in the side through which the light reached the mirror. The earthenware was dark-coloured outside and white inside, and the shade was an advantage in affording an additional screen to the eyes. Mr. Ingpen, however, took objection to the cylinder being white inside; he considered black much better as avoiding glare. Mr. Ingpen also referred to a specimen of Diatomaceous earth presented by the Rev. J. J. Halley, of Williamstown, Victoria. This was discovered in cutting a drain through low-lying lands near the mouth of the river Yarra. It was very interesting to obtain contributions from distant countries, especially when sent by residents. Slides of this deposit would be prepared for the cabinet of the Club. The forms were similar to the well-known "Yarra-Yarra" earth, and included several interesting species.

Mr. A. D. Michael briefly described a specimen of *Glyciphagus palmifer*, exhibited in the room, and to which some interest attached from the fact of its having recently been found for the first time in this country.

The thanks of the meeting were voted to Mr. Michael for his communication.

Mr. T. C. White read a paper "On Insect Dissection," in which he described the best methods of manipulation, and gave numerous hints as to the apparatus best suited to the purpose, together with some suggestions as to mounting and examination.

Mr. Ingpen said they must all feel much indebted to Mr. White for his interesting paper, which was upon a subject which he had long wanted to

see brought before the Club, and upon which many of the members would be very glad to get some information. The first part of the paper mentioned dissecting under the microscope with an erector. Now the ordinary form of erector was excellent as applied to a telescope, but under a microscope it was simply abominable. There were, however, various kinds of erectors, and one which had been shown by Professor Abbé, made by Zeiss, was about the best he had seen. It consisted merely of a single achromatic combination of about two inches focus, with a stop placed above it, and it gave a beautiful definition. If they took an achromatic doublet and put it into a tube with a smallish aperture above it, and in its solar focus, and then placed it in the tube of the microscope, they would find it would prove a far finer erecting glass than those generally used.

Mr. E. T. Newton said that some time since he had the advantage of speaking to Mr. Loy upon this subject, and, particularly upon the best methods of holding very small insects; that gentleman suggested a very admirable plan, which consisted in taking an ordinary lead pencil, and sticking a piece of shoemaker's wax on the end of it, to which the insect was caused to adhere. He could in this manner manipulate a flea, and by removing first the integument, and then putting the insect into water, the various parts would begin to swell out in such a way that dissection was greatly facilitated. Whilst admitting the great value of dissection as a means of understanding insect anatomy, he wished to call attention to the great value also of sections, which often gave information as to the relative connection of the various parts which could not be otherwise obtained, and although they were not, perhaps, of much use in such cases as that of the alimentary canal, they were of the greatest value in forming a clear idea of other parts, such as the head. Mr. Newton then proceeded to show, by means of drawings upon the black-board, certain particulars of the highest interest and importance, which had been made out by means of sections of the heads of Ants and Wasps.

Mr. T. C. White said that he had felt at first inclined to apologise for the poverty of his paper, but certainly should not now do so, seeing that it had been the means of bringing out the very interesting remarks which they had just heard from Mr. Newton. His object in bringing the matter forward was to try and incite others to the study of the comparative anatomy of insects. Cutting sections successfully was, however, a matter which required a delicacy and manipulative skill which "only a Newton" could command! With regard to an erecting glass, he was fully aware of its many disadvantages when used with instruments of ordinary construction, particularly as the instruments had to be used for dissecting purposes when in the upright position; if he could afford a Stephenson's binocular, of course it would be more comfortable. One more hint he would give, and that was if they wished to dissect insects in the morning, they should not, for the sake of steady hands, smoke too much at night.

The thanks of the meeting were unanimously voted to Mr White for his paper.

Announcements of meetings for the ensuing month were then made, and

the proceedings terminated by a conversazione, at which the following objects were exhibited :—

Blade of Oat, stained	Mr. T. H. Buffham.
Lophopus crystallinus	Mr. W. G. Cocks.
Diatomaceæ, from Penang	Mr. A. L. Corbett.
Tenthredo cinctus	Mr. F. Enock.
Sections of Brazil Nut	Mr. W. H. Gilburt.
Longitudinal Section of leg of Human Fœtus	Mr. J. J. Hunter.
Cuticle of Sea Buckthorn	Mr. C. Le Pelley.
Section of Liver of Kitten	Mr. Jno. Locke.
Glyciphagus palmifer	Mr. A. D. Michael.
Pappus from *Rhodanthe maculata*... ...	Mr. T. S. Morten.
Section of *Eucalyptus globulus*	Mr. F. H. Ward.

Attendance—Members, 81; Visitors, 11.

February 8th, 1878.—Conversational Meeting.

The following objects were exhibited :—

Skin of Haddock, showing pigment cells ...	Mr. F. W. Andrew.
Hairs of *Alyssum montanum*	Mr. C. G. Dunning.
Tegenaria atrica	Mr. F. Enock,
Ovipositor, &c., of Gadfly	Rev. H. J. Fase.
Fructification of *Dicksonia antarctica* ...	Mr. W. H. Gilburt.
Section of stem of fig	Mr. H. G. Glasspoole.
Head of earwig	Mr. A. H. Halley.
Section of Human Mammary gland ...	Mr. J. J. Hunter.
Granite, enclosing Mica schist	Mr. M. H. Johnson.
Muscular fibre	Mr. A. Martinelli.
Medusiform gonozoid of *Obelia geniculata*	Mr. A. D. Michael.
Stictodiscus Buryanus	Mr. W. Moginie.
Gneiss, from Fribourg	Mr. G. J. Smith.
Syenite, from Upsala	„ „
Various absorption spectra, under Hilger's Spectroscope	Mr. F. H. Ward.

Mr. Ingpen continued his demonstration of the principles of the Achromatic Microscope.

Attendance—Members, 54 ; Visitors, 7.

February 22nd, 1878.—Ordinary Meeting.

Henry Lee, Esq., F.L.S., &c., President, *in the Chair.*

The minutes of the preceding meeting were read and confirmed.

Mr. Robert M. C. James and Mr. Samuel H. Needham were balloted for and duly elected Members of the Club.

The following donations were announced :—

"Science Gossip"	from the Publisher.
"The Medical Examiner"	„ „

"Proceedings of the Belgian Microscopical Society"	from the Society.
"The Octopus," by Mr. Henry Lee ...	„ the Author.
"Thudichum's Manual of Chemical Physiology"	„ Mr. Freeman.
"Brongniart's Mineralogy"	„ Mr. M. H. Johnson.
"Annals of Natural History"	by purchase.
1 Slide (*Glyciphagus palmifer*)	from Mr. Michael.
12 Slides (Foraminifera)	„ Mr. Hailes.
1 Slide (Diatoms, from Yarra River) ...	„ Mr. Priest.
1 Slide (Diatoms from Yarra River) selected and aranged...	„ Mr. Topping.
A series of Slides of parasites of the Rat, Rabbit, &c.	„ Mr. Beulah per Mr. T. Curties.

Photographs of the Rev. W. M. Hutton, the Rev. W. Quekett, and Mr J. R. Eddy, were presented to the album.

The thanks of the meeting were unanimously voted to the donors.

Mr. Ingpen said it might be useful to some members to know that ground glass slides could be obtained with a surface fine enough for microscopical use. This surface was in the condition to which plate-glass was reduced immediately before polishing, and was without any of the roughness observable in ordinary ground glass. The specimen which he had brought for inspection was prepared by Messrs. Chance, and he believed slides of it could be obtained at Messrs. Horne and Thornthwaite's.

Mr West read a paper "On Microscopic tracings of Lissajous' Curves," the subject being illustrated by specimens exhibited under microscopes in the room; also by larger figures of the same kiud, drawn upon smoked glass, and a number of the well-known curves produced by Mr Tisley's machine.

Mr Ingpen read a letter from Mr. Wm. Webb, whose skill in microscopic writing and ruling was known to most microscopists, highly praising Mr. West's beautiful productions. Mr. Webb s opinion upon the subject was entitled to great weight from the great beauty of his own productions, and his known skill in fine writing and ruling. Mr. West had not referred to the value as test objects of some of these figures, in respect of the possibility of measuring the lines of which they were composed. If they had any figure in which the lines were more or less elliptical, they might probably be so drawn that a band should be produced, showing wide lines at the top of the ellipse, whilst the same number would be drawn very much closer together towards the middle of the figure. In this way they might obtain a series of bands of known number and character, and yet so close as to be a very fair test for an objective. He thought that this was a point at which these slides ceased to be mere toys. The difficulty had been mentioned as to the right kind of illumination to be used in examining these very delicate figures, and he thought it would be a severe test to put one of these slides before an amateur and ask him to show it properly.

Mr Curties said he had great pleasure in assisting Mr. West in the illumi-

nation of these objects, and they had certainly turned out better than he had expected. He thought the best results had been obtained by a spot lens, thrown somewhat out of focus; then the water-marking came out very beautifully; the stereoscopic effect also was very remarkable.

Dr. Matthews said he could testify to the extreme beauty of these curves, and also to the stereoscopic effect, which seemed to be due to some illusion. These figures appeared to him to throw some light upon the subject treated of by Mr. Sorby, in one of his addresses, as to the ultimate limit of vision, for, as the lines approached one part of the curve, they became so close that it would be impossible to estimate their value unless their number had been previously known.

Mr. Ingpen said he should like to ask Mr. West what kind of diamond point was used in drawing these figures, and also how it happened that the crossings of the lines, though so fine, showed no signs of splitting.

Mr. West could only say that he thought he had been rather fortunate in fixing the diamond in a good position; the point seemed to be rather blunt, and, in shape, like that of a minie bullet.

Mr. Ingpen enquired what kind of glass was used?

Mr. West said he had used the ordinary microscope slips. He believed these were made of two sorts of glass, some being patent plate and others flatted crown. His chief difficulty had been with the surface of the glass. He did not think that the glass used for ruling micrometers would answer so well.

Mr. Powell, in reply to a question from Mr. Ingpen, said that the glass used for micrometers was the ordinary thin covering glass.

Mr. Curties said there was a great difference between the cuts in the case of a micrometer line and the lines drawn by Mr. West; in the latter the point seemed rather to slide along the surface than to scratch into it.

Dr. Matthews said that, according to what he had seen of these lines, they seemed to be more like shallow cuts than scratches, in which there had been a removal of surface, so that if this were the case he should hardly expect any dust to be produced. Every one who had made use of a glazier's diamond was aware that there were two kinds of marks which could be made with it, one being a true cut, and the other a scratch.

Mr. Spencer said that whenever a cut was made there was no dust produced. Dust only was made when the attempt to cut was a failure. He had often tried to get a cut with the black diamonds, but could never succeed. The true cut was something physical and molecular, rather than mechanical.

Mr. Ingpen said they must have a natural crystal of diamond to cut with; a point of a broken surface would be of little use.

Dr. Matthews remarked that in the new steel roller for cutting glass the curves of the edge were much the same as in the cutting diamond, and the same effect on the glass was produced. There was no cut *through* but it caused some kind of molecular disturbance.

Mr. West said that he had found dust in the course of his experiments, but he had not examined it. He had also tried to fill in the lines, but had not yet been successful with either lamp-black and oil, carmine, or aniline; he

had not yet tried a fine kind of graphite, which he was told might, perhaps answer better.

The President proposed a vote of thanks to Mr. West for his interesting paper, which was carried unanimously.

Notice was given that at the next gossip night Mr. Newton would explain the process of cutting soft tissues, and that at the next ordinary meeting there would be a paper read "On a New Micrometer," by Mr. Burch.

The proceedings then terminated with a conversazione, at which the following objects were exhibited :—

Specimen of *Gabbio* (Polarized)	Mr. F. W. Andrew.
Fungi on cover of an old book	Mr. Batchelor.
Fossil Fern Spores, &c., from Lancashire lower coal measures	Mr. T. H. Buffham.
Obisium orthodactylum (unpressed)... ...	Mr. F. Enock.
Common house Gnat	Rev. H. J. Fase.
Wing of house Cricket	Mr. A. H. Halley.
Stamens of *Deutzia gracilis*	Mr. Martinelli.
Palate of *Trochus lineatus*	Mr. Moginie.
Spiral fibre of seed coat of *Collomia* ...	Mr. J. W. Reid.
Scrapings from Atlantic Cable, 880 fathoms	Mr. F. Reeve.
Sections of Human Teeth	Mr. Topping.
Hair of Indian Bat	Mr. Woollett.
Specimens of ruled curves on Glass, in illustration of his paper...	Mr. West.

Attendance—Members, 74; Visitors, 7.

March 8th, 1878.—Conversational Meeting.

The following objects were exhibited :—

Tongue of Mouse, injected	Mr. F. W. Andrew.
A Blade of Grass, stained	Mr. T. H. Buffham.
Geophilus longicornis (Snake centipede) ...	Mr. F. Enock.
Leaf of *Dendro-calamus giganteus*, stained	Mr. W. H. Gilburt.
Aulacodiscus Kittonii	Mr. H. G. Glasspoole.
Bladder of Guinea-pig, injected, showing Peyer's glands	Mr. J. J. Hunter.
Graphic Granite from Portsoy	Mr. M. H. Johnson.
Foraminifera from Indian Ocean Soundings	Mr. B. W. Priest.
Cynoglossum sylvatica	Mr. J. W. Reid.
Section of Human Skin	„ „
Graphic Granite from Scotland	Mr. G. J. Smith.
Ptychodus tooth from chalk...	„ „

Mr. E. T. Newton gave a detailed explanation of the method of preparing and cutting sections of soft tissues.

Attendance—Members, 71; Visitors, 5.

March 22nd, 1878.—Ordinary Meeting.

Dr. J. Matthews, F.R.M.S., Vice-President, *in the Chair.*

The minutes of the preceding meeting were read and confirmed.

The following gentlemen were balloted for and duly elected members of the Club:—The Ven. Archdeacon Darby and Mr. E. Darke.

The following Donations to the Club were announced:—

"The Journal of the Royal Microscopical Society"	from the Society.
"The American Journal of Microscopy" ...	„ the Publisher.
"Science Gossip"	„ „
"Annual Report of the Geologists' Association"	„ the Association.
"Proceedings of the Belgian Microscopical Society"	„ the Society.
"The Analyst"	„ the Publisher.
"The Medical Examiner" (weekly) ...	„ „
"Reprint of a Paper on *Melicerta*" ...	„ Mr. F. A. Bedwell.
"The American Naturalist"	in exchange.
"Annals of Natural History"	by purchase.
Six Specimens of "Solid" Insect Mounting...	from Mr. Curties.
Two Slides	„ Mr. Glasspoole.
Seven Slides of Polyzoa	„ Mr. Michael.
Twenty-two Slides of Sections	„ Mr. Newton.

The thanks of the meeting were unanimously voted to the Donors.

The Secretary exhibited and described a new form of air pump for microscopical mounting purposes, devised by Mr. Edmund Gardner, and carried out by Mr. Browning. Two patterns of the instrument were shown, the simpler of which consisted of a glass tube cemented to the exhausting syringe at one end, and closed at the other by a screw cap rendered air tight by means of an india-rubber washer. The slide to be operated upon was placed in the tube, and the effect produced by the exhaustion of the air could be readily observed. A more elaborate form of the apparatus was also placed upon the table.

The Chairman said that the great difficulty with regard to the ordinary form of air pump was in keeping the receiver air tight, but by the use of vulcanised rubber, the vacuum in the little instrument before them could be easily maintained.

Mr. Thos. Spencer enquired if anything was known as to the cost of these instruments?

The Secretary had not been informed, but he believed it would be certainly less than that of most of the usual forms, on account of its extremely simple character.

A paper by Mr George J. Burch, of Cheshunt College, "On a New Micrometer," was read by Mr. Curties, the subject being illustrated by diagrams, and by the exhibition of several forms of the apparatus described. Mr. Curties, at the conclusion of the paper, expressed his inten-

tion of making a model from the design of Mr. Burch, and of presenting the same to the Club.

The Chairman said that this very clever invention was calculated to promote what every microscopist should do, namely, draw everything to scale. It appeared to be an ingenious attempt to make one eye do what had formerly been done by both. He had much pleasure in moving a vote of thanks to Mr. Curties for reading the paper, and would beg him to convey the thanks of the Club to the gentleman who had been at the trouble of elaborating it.

Mr. Ingpen said that he had an interesting paper to read by Mr. Staniforth Green "On Insect Mounting." Mr. Green had resided some years in Ceylon, and made good use of the opportunities there afforded to him of collecting and mounting insects. He was one of the first to mount them in the solid, and to protest against the ordinary method of compressing them, and he now gave them his process of mounting and preserving. The paper was then read to the meeting.

Mr. Thomas Spencer wanted to know what the Anti-Vivisectionists would say to the paper, because the insect must, of course, be killed before they commenced to operate, and it was probably killed rapidly by the action of the turpentine.

Mr. Ingpen said that most insects were killed instantaneously by placing them in turpentine; one of the quickest means of killing them was by plunging them into boiling water.

The Chairman could assure Mr. Spencer that turpentine was an undoubted anæsthetic, and therefore no doubt these insects died happily. He had often prescribed turpentine to patients to be used as an outward application, and had ascribed its beneficial effect not so much to its action as a counter irritant as to its anæsthetic effect upon the patient.

Mr. Spencer said he had no doubt that death was quick, and what they might call instantaneous; but what might be to a human being only half a second of time might be half a minute to the insects. However, he only spoke of the matter philosophically.

Dr. Matthews was very glad the subject of mounting insects in their natural condition was receiving attention; he himself had been almost one of the first to protest against the process of squashing them.

Mr. Ingpen thought it important that they should get all the information they could on the subject, especially with regard to getting specimens from foreign parts with the least amount of injury. The extremely beautiful manner in which objects mounted by Mr. Green's plan were shown by the paraboloid, the perfect condition of the trachea, eyes, and muscular tissue, rendered this process a matter of the greatest interest.

A vote of thanks to Mr. Staniforth Green was unanimously carried.

Announcements of meetings and excursions for the ensuing month were then made, and the proceedings terminated with a conversazione, at which the following objects were exhibited:—

Tongue of Honey Bee	... ...	Mr. F. W. Andrew.
Shell of *Haliotis splendens*	... ...	Mr. A. L. Corbett.

Micro-photograph of Professor Quekett ...	Mr. T. Curties.
Spinnerets of Garden Spider (unpressed)...	Mr. Enock.
Growing Point of *Equisetum*	Mr. W. H. Gilburt.
Section of Hedge Maple	Mr. Glasspoole.
Scale of Haddock	Mr. Goodwin.
Section of Sucker of *Octopus*	Mr. J. J. Hunter.
Scale of *Lepisma*	Mr. J. Locke.
Stellate Hairs of *Deutzia*	Mr. Martinelli.
Crystals from Opium liniment	Mr. T. H. Powell.
Section of marble	Mr. W. S. Smith.

Attendance—Members, 80; Visitors, 8.

April 12th, 1878.—Conversational Meeting.

The following objects were exhibited:—

Young Salmon Trout...	Mr. F. W. Andrew.
Head of *Hyous papillosa*	Mr. Dunning.
Tongue of Sphinx Moth	Mr. Enock.
Red Snow—*Protococcus nivalis*	Mr. H. G. Glasspoole
Eggs of Vapourer Moth	Mr. W. Goodwin.
Section of Chalcedony	Mr. G. Green.
Diptera	Mr. A. H. Halley.
Knee-joint of Human Fœtus	Mr. J. J. Hunter.
Chert from Axmouth...	Mr. M. Hawkins Johnson.
Hydractina	Mr. A. D. Michael.
Gemellaria coricata	Mr. T. S. Morten.
Polyzoa	Mr. Ogilvy.
Yeast Plant	Mr. A. C. Tanquery.

Mr. W. H. Gilburt gave an interesting description of the method of bleaching and staining vegetable tissues.

Attendance—Members, 68; Visitors, 5.

April 26th, 1878.—Ordinary Meeting.

Henry Lee, Esq., F.L.S., &c., President, *in the Chair*.

The minutes of the preceding meeting were read and confirmed.

Mr. George W. Gibbins was balloted for and duly elected a member of the Club.

The following donations to the Club were announced:—

"Proceedings of the Royal Society" (two parts)...	from the Society.
"The Popular Science Review"	„ the Publishers.
"The American Journal of Microscopy" ...	in exchange.
"The Annals of Natural History"	by purchase.
"Report of the Croydon Microscopical Club"	from the Club.

"The Quarterly Journal of Microscopical Science" ... ... } by purchase.
"Report of the Microscopical Society of Liverpool" ... ... } from the Society.
"Science Gossip" ... ... „ the Publisher.
"The American Naturalist"... ... ... in exchange.
"Harting's Treatise on the Microscope" ... from Mr. F. Crisp.
Six Slides of Desmids ... ... „ Mr. Tatem.
One Slide—Red Snow ... ... „ Mr. Glasspoole.
Photograph of Dr. Matthews, for the Club album.

The thanks of the meeting were unanimously voted to the Donors.

The President said that Dr. M. C. Cooke had laid before the committee a plan which had received their cordial approval, and which he would ask that gentleman to explain to the meeting.

Dr. M. C. Cooke said that having found a certain plan which he had adopted for years of considerable use to himself and friends, he had thought that the larger association of friends who formed the Club might gain some advantage from it also, if he showed them how it might be carried out. They all knew that he attached great value to drawings made from objects under observation—in the progress of years names might be changed, and organisms might be placed in other classes where it would be difficult to recognise them, but a faithful drawing was *always* of value. When Ehrenberg had only a £5 microscope to work with he made drawings of what he saw, which were now regarded as of great value, although his descriptions were, many of them, become out of date. In studying fungi he had made a practice of obtaining drawings from all sources, and of every species which it was possible to obtain, and he had collected altogether about twenty thousand such drawings of fungi, mounted in uniform size and kept in portfolios for easy reference; and he had thought that this plan would be of value in the Club, and might be of special use at their gossip nights. Say the subject illustrated was that of *Algæ*, for instance—any one being interested in the subject, and desirous of identifying any specimens, might come to the Club on a gossip night, and having looked over a box containing figures of *Algæ* would probably be able to obtain the information he required. The committee approving of the suggestion, had authorised the purchase of paper of the size found most convenient, and ruled for the purpose; any one who had any drawings at disposal, and was willing to give them for the purpose, might obtain some of this paper upon which the drawings were to be mounted. The mounting would, of course, have to be done by the member presenting the drawings, because it would not be fair to ask any honorary officer of the Club to undertake this trouble. Care should be taken to mount illustrations of one species only on a single sheet, because the sheets were intended to be kept like a pack of cards, so as to be sorted and arranged as easily as possible; where drawings were taken from books, or where engravings were mounted, members should in all cases state the work from which the extracts were made; and when original drawings were contributed, the name of the con-

tributor should always be given. These suggestions, if carried out, would add very greatly to the value of the specimens.

The President said he need not add that the suggestions made by Dr. Cooke met with his hearty approval, and that the committee had decided to purchase a ream of paper the same size as that of the specimens brought to the meeting by Dr. Cooke. He should be very glad to see this new movement encouraged.

Mr. J. G. Waller read a paper "On Variation in *Spongilla fluviatilis*," the subject being illustrated by diagrams showing the close resemblance of several so-called species.

The President, in inviting observations upon the paper, said that he so far agreed with what Mr. Waller said, that when some years ago he had a specimen of *Spongilla Meyena* sent to him by Dr. Bowerbank, he wrote to ask him if he had not made a mistake and sent *S. fluviatilis* instead, for he could not see any difference. Having called attention to a specimen brought by the late Mr. J. K. Lord from Vancouver's Island, he enquired if Mr. Waller held that there was a specific difference between *S. fluviatilis* and *S. lacustris*.

Mr Waller said he quite believed these to be different, although he had shown that they had been found growing together in the same locality.

Dr. Matthews asked if the so-called species did not depend upon such things as food, temperature, and the mineral constituents held in the water? He thought these might be possible causes of the variations, and he was inclined to lay great stress upon the quantity of silex contained in the water. He added his protest to that of Mr. Waller against the terrible multiplication of species.

Votes of thanks to Dr. M. C. Cooke and Mr. Waller for their communications were then proposed by the President, and carried unanimously.

Announcements of meetings and excursions for the ensuing month were then made, and the proceedings terminated with a conversazione, at which the following objects were exhibited:—

Cuticle of *Ficus elastica*, showing stomata	Mr. F. W. Andrew.
Section of Echinus Spine	Mr. A. L. Corbett.
Plumose Antennæ of *Biston hirtaria* ...	Mr. F. Enock.
English Tingis (?)	Mr. H. E. Freeman.
Section of Epidermis of Rat	Mr. W. H. Gilburt.
"*Daphnia pulex*"	Mr. Goodwin.
Flour Mites	Mr. H. R. Gregory.
Micrasterias denticulata (mounted) ...	Mr. H. F. Hailes.
Volvox globator ditto ...	
Young Sea Anemones	Mr. A. H. Halley.
Salivary Glands of Kitten (injected) ...	Mr. J. J. Hunter.
Glyciphagus spinipes	Mr. A. D. Michael.
33 Sections of the head of one *Blatta orientalis*	Mr. E. T. Newton.
Phlogopite—a variety of Mica	Mr. J. Woollett.

Attendance—Members, 83; Visitors, 5.

On an Apparatus for Facilitating the Use of "Powell's Small Bull's-eye" Illuminator in the Resolution of Test Objects.

By Geo. Williams.

(Read May 24, 1878.)

Plate VI.

The attention of microscopists having lately been much devoted to the determination of the merits of object-glasses of recent manufacture, and to the more or less successful exhibition of beads, lines and *striæ* on diatoms and other objects, especially with reference to the several condensers and other optical means and appliances by which the desired results can be best obtained, I have thought that a short paper bearing upon the latter portion of the subject might be interesting; and I beg leave to introduce to the meeting, this evening, a contrivance of mine which I have designated "An Apparatus for Facilitating the Use of 'Powell's small Bull's-eye' Illuminator in the Resolution of Test Objects."

A very simple, but at the same time highly effective, method of resolving the transverse *striæ* or ribs of *Amphipleura pellucida* is that employed, and first devised, as I believe, by Messrs. Powell and Lealand. It consists in concentrating an intense beam of light upon the frustule, at a very extreme angle, by means of a small "bull's-eye" of very short focus. For this purpose a super-stage is required, which may be briefly described as a thin platform, slightly larger than an ordinary 3 × 1 slip, raised upon uprights about an inch above the level of the principal stage, the base bearing the uprights sliding on upon the dovetails which take the upper stage-plate, *that* having been first removed. The platform, thus fixed, assumes a position *perpendicular* to the body of the microscope, and has a $\frac{3}{4}$" central opening, horseshoe-form, cut out from its side edge to about $\frac{2}{3}$rds of its width; the light, therefore, on one side of the platform, meets with no obstruction. The slip being laid upon the

platform beneath its springs, the flat side of the "bull's-eye" is brought close up to the side edge of the slip, a brilliant beam is concentrated upon, and thrown across, the slide, the proper illumination is obtained by the necessary manipulation, and the markings are thus resolved.

In order, however, to show these transverse lines or *striæ* with this "bull's-eye," it is necessary that they lie at *right angles* to the direction of the light. A selected slide, prepared on purpose, of course provides for this, the mounter arranging the frustules on the cover, and fixing it so that they lie *across* the slip; but, to say nothing of the great difficulty of thus arranging *A. pellucida* (which high skill and much patience can alone accomplish), the number of the valves is generally limited to some half-dozen, and these few mostly turn out to be *so extremely difficult* of resolution, and are otherwise so unsatisfactory as to render the slide of comparatively little use. A good ordinary strewed slide, on the contrary, contains hundreds of the valves, and amongst them may be found, by diligence, many on which the lines can be seen with reasonable ease; but it is obvious that the "bull's-eye" can be made to successfully operate upon those specimens only which happen to lie in the direction of the width of the slip, or within very narrow limits thereof; the rest of the specimens, and possibly the best, being incapable even of examination owing to their unsuitable position. To place any one of the latter in the right direction it is clear that the only course is to turn the slide by the rotating motion of the microscope; but the *length* of the slip quickly interferes with, and pushes aside, the "bull's-eye," and there is nothing for it but to abandon the examination of *that* valve. To overcome this difficulty, and put an end to the annoyance of seeing crowds of frustules which one cannot even attempt to resolve, I have devised the easily-made and inexpensive apparatus described below; and I have ventured to bring it to the notice of the members of the club, in the hope that it may meet with approbation, and extend the use of this excellent illuminator, which will be found to give very good results with *A. pellucida*, and to be equally effective in resolving other tests; always, of course, assuming that an objective be employed which is competent to the task.

Fig. 1 is a disc of thin plate, or crown, glass, $\frac{3}{4}$" diameter, on which may be mounted diatoms in balsam, or dry strewed on the cover. Any cover carrying *dry* diatoms can be easily removed from

its slip, transferred to the disc, and cemented thereon, as shown in the figure. A *rough edge* to the disc greatly facilitates its handling.

Fig. 2 is a tubular setting or holder, 1″ long and $\frac{3}{4}$″ diameter inside measure; the top cut out so as to leave 3 equidistant $\frac{1}{4}$″ uprights, having small lips upon which the disc (fig. 1) is to rest. The tips of the uprights are slightly inclined inwards to spring lightly against, and steady, the disc, to overcome the suction of an immersion objective. The uprights should be as slender as possible, consistent with the needful strength, that as little obstruction as may be shall be presented to the passage of the light beneath the disc.

Fig. 3 is a brass plate 3″ by 1″, having a tube $\frac{5}{8}$″ long fixed into central hole. The tube to well fit fig. 2, the latter resting on the flange, and rotating easily and smoothly, but without any "shake." The small milled heads screw the plate to the principal stage of the microscope (two holes being tapped in the stage-plate to receive them), that the disc may be subject to the concentric rotating and other mechanical motions; so that the whole mount may be brought successively under the objective. Any other mode of firmly fixing the plate to stage may be substituted for the milled heads, which are suggested merely as an easy but secure method of fastening.

Fig. 4 is a brass rod to support the "bull's-eye"—a plano-convex lens of about $\frac{3}{4}$″ diameter and $\frac{1}{2}$″ focus. The rod is furnished with ball and socket joint (to give universal motion), to be inserted in the usual fitting in the head of the carrier (Ross model), or in the crane arm (Jackson model). The rod is curved to advance the "bull's-eye" approximately into position, which is afterwards brought close to the disc by the ball and socket joint. The shape of the curve will depend upon the form of the microscope to which the rod may be fitted. The cell of the "bull's-eye" is attached to the rod by a tongue-joint that it may be "kept square" whatever the inclination of the rod. The rod must be sufficiently long to allow the "bull's-eye" to be conveniently manipulated; it is divided in the figure to show the necessary milled stud at the tail-end. The pin of the joint should fit into a *square* hole, thus confining all motion to the joint itself, and preventing any tendency to "crawl." The socket should be carefully packed to obviate all jumping motion in the joint, the ball moving freely.

Fig. 5 is a brass plate, 3″ by $1\frac{1}{4}$″, with central aperture $\frac{3}{4}$″ diameter, turned out so as to leave a very thin and narrow flange, as shaded in the figure. This aperture is to receive and support

the disc on the stage of the microscope, in case it should be desired to examine the mount as an ordinary slide by illumination from the sub-stage. The disc will require to be kept steady by a slight spring ring to counteract the suction of the immersion objective.

It will, I think, be seen that by mounting the diatoms on a small disc instead of the ordinary slip, and placing it in the holder above described, the whole of the frustules on the cover are brought under the control of the observer, who, by mere rotation, can bring any one of them into the necessary position, and thus ultimately succeed in examining a large majority.

Having selected a specimen, and rotated it into position, one of the uprights of the disc-holder may chance to stand immediately between the diatom and the light; in that case, all that is necessary is to turn the disc in its setting, and again rotate the holder until the object is again in position; a glance will show whether or not the light will now pass between the uprights, if not, the turning of the disc and rotation of the holder must be repeated until it does so.

The turning of the disc and rotation of the disc-holder can be easily managed with thumb and finger, under a quarter-inch objective; indeed, with a well-made apparatus, but little difficulty has been found even under a $\frac{1}{20}$th, aided by a mechanical stage in good working order. The rotation can, of course, be effected by the use of the concentric motion of the microscope stage; but, in practice, it will be found far preferable to rotate the holder itself to approximately place the object, resorting to the concentric motion to effect only the *niceties* of position; the milled heads which work the mechanical stage will then retain their normal situation (or very nearly so), at the right side of the microscope, and be, consequently, much more convenient for the manipulation of the observer.

On the Influence of Diffraction in Microscopic Vision.

By Frank Crisp, LL.B., B.A., Sec. R.M.S., V.P.Q.M.C.

(*Read June* 28, 1878.)

Plate VII.

The subject which I bring before you this evening is now, so far as date is concerned, somewhat of an old story, but unlike some of the other old stories of the world which are being daily repeated it is one which, I think, will peculiarly bear repetition—the discoveries of Professor Abbe, in relation to the resolution of minute structure, being as remarkable as any that have been made in ancient or modern Microscopy.

I intend to deal only with the most elementary parts of the subject, advisedly abstaining from attempting to present any more complete *résumé*, as I am convinced that its real significance and importance will be far more likely to be appreciated if I confine myself to the leading points. Moreover, there will be this advantage, that I shall have left ample room for entertainment on future evenings, and every one will be able to leave to-night with the knowledge that he can occupy very many leisure hours in further investigations.

I shall not, perhaps, be far wrong if I assume that there are some present who are not aware that within the last two or three years the theory of microscopic vision has received a new and important development, so that some of the old notions—which seemed to depend on the simplest principles, and not to be susceptible of innovation—have been completely exploded, leaving a feeling of not a little wonder that such simple facts had escaped observation, and that we should have had them so long, literally right under our noses, without any appreciation of their importance.

It is desirable at the outset to point out the two leading ideas hitherto held, which are now known to be erroneous.

The first error relates to the mode of formation of the microscopic image. It will be remembered that in our books on optics or the microscope, the images of objects are stated to be formed in that

instrument on ordinary dioptric principles, that is, in the same way in which they are formed in the telescope or a camera, and if any microscopist were asked to describe the way in which a diatom or other lined object is seen in the microscope, it would have been in this manner that the explanation would, without hesitation, have been given. It had never been suggested, prior to Professor Abbe, that that (which may be termed the dioptric method) was at all incorrect.

One result of this view was that, in the manufacture of objectives, very erroneous methods came to be adopted—methods that were perfectly correct if the images were formed dioptrically, but entirely inapplicable if that theory was unsound.

The second error relates to angular aperture.

Not long after achromatic object-glasses were first made, Dr. Goring found that the markings on particular objects, such as the scales of the wings of insects, could not be seen by some object-glasses, while with others, of equal magnifying power, they were clearly visible. This led him to the important discovery that the resolving power (or, as he termed it, the "penetrating" power) of an objective depended upon the extent of its angular aperture.

One of the explanations given of the cause of this quality of the objective was that, as by the larger aperture, rays of greater obliquity were admitted, structural details became more plain, in the same way that the inequalities on a white wall or a person's face are plainer when the light falls upon them obliquely—casting shadows—than they are by direct light.

This theory has remained without alteration to the present day, and some writers have exhibited the most praiseworthy efforts to account for some of the anomalies that the theory did not satisfy, much in the same way as the old astronomers who, when the motions of a planet seemed to become erratic, did not throw over the theory which they had adopted to account for the motions, but added additional crystal spheres, until at last the whole thing was so marvellously complicated that it is a wonder how any sane person could have believed in it.

I now come to the phenomena which show that a special and important part of the functions of the microscope has been overlooked, and that both the theories just referred to, that of the dioptric formation of the image, and that of angular aperture are, in the case of lined objects, erroneous ; the explanation, in fact,

equally applies to granular bodies, or others with minute structural details, but fine lines present the simplest phenomena, and are best suited for the present demonstration.

I assume a general acquaintance with the phenomena of the interference of light, and with the so-called diffraction images that are produced when a flame (for instance) is looked at through a fine grating, such as lines ruled on glass. I have, however, some gratings for examination after the meeting, which will make the experimental part of the subject, at any rate, very plain.

If any, not too finely-lined, object is focussed on the stage of the microscope, and the eye-piece is removed, on looking down the tube, instead of seeing only a small circle of light, we see, in addition, other subsidiary circles, or rather ovals (as shown in Figs. I, II), which, if white light is used, appear with the colours of the spectrum, the blue being always towards the centre.

The central circle is the direct image of the aperture in the diaphragm, and, when the eye-piece is in position, gives a view of the object on an illuminated field.

The ovals are the diffraction images (or "spectra") of the opening, and any two of them together will give an image of the object on a dark field. They are formed by the interference of the light in consequence of its passage through the object, in the same way as the images of a flame are produced by a grating in the ordinary diffraction apparatus.

In the case of the scales of insects or valves of the diatoms, the variations in their structure, whether arising from unevenness of surface, from the unequal transparency of parts of the structure, or from holes, or whatever it may be, will produce precisely the same effect upon the object as is produced by the lines ruled on glass, the light transmitted through such objects not entering the object-glass in the same direct line which it held in its course from the mirror to the object, the structure causing a number of rays to be separated from the rectilinear rays on each side—these deflected rays forming larger or smaller angles with the lines of direction of the unchanged rays, according to the greater or less minuteness of the structure.

The theory propounded by Professor Abbe, as the result of his observation of these diffraction images is, that the microscopic image consists, as a general rule, of *two superimposed images*, each distinct in origin and character, and capable of being separated

and examined apart from each other—one image being that by which the *contour outlines* of the larger parts are formed, the other image giving the delineation of *minute structure*. So in the case of an object with lines closer than $\frac{1}{2500}$ of an inch apart, the image seen by the eye is formed not simply by the central dioptric beam, but by the joint action of that and the diffraction images and their exact union in the upper focal plane of the objective.

How important an influence the diffraction spectra have on the formation of the image, may be seen by the following experiments, which, for the moment, I must explain by means of diagrams, though they can be verified after the meeting under the microscope.

Fig. I represents the appearance in the field of the microscope of an object formed of two sets of lines ruled through a thin film of silver deposited on glass, the lower set being twice as close as the upper ones.

Fig. II shows the appearance which is presented on removing the eye-piece and looking down the tube of the microscope, the central circle in each series is the dioptric beam, the others being the diffraction spectra. It is important to observe that the distances of the spectra apart are inversely as those of the lines, the upper (widely separated) lines producing spectra twice as close as those of the lower.

If we now place over the back of the object-glass a diaphragm like Fig. A, the diffraction spectra will be admitted, as well as the central beam, when the slit of the diaphragm is at right angles to the direction of the lines ; when, however, the diaphragm is turned round 90°, so that the slit is vertical, the whole of the diffraction spectra are shut out, and nothing but the dioptric beam is admitted.

If, therefore, the diffraction spectra contribute, as the theory assumes they do, to the formation of the image, some change ought, of course, to be perceptible when they are thus excluded. It will be found that, as the diaphragm is turned round, and the diffraction spectra disappear, the lines also disappear, and not a trace of them can be seen (Fig. a).

This demonstrates the importance of the spectra in the formation of the true image, and we may now carry the demonstration a step further, and show what influence they may have in the formation of false images.

Referring again to Fig. II, if we are able by any means to make the spectra of the upper lines identical with those of the lower, it

would be reasonable to assume, if the theory is correct, that the images of the two sets of lines, as seen by the eye through the microscope, would resemble each other.

This object may be attained by placing at the back of the object-glass the diaphragm, Fig. B. It will be seen that when this is placed over Fig. II, each alternate one of the spectra of the upper (more widely separated) lines is cut off, so that they become identical with those of the lower lines. On now replacing the eye-piece, and looking at the object in the ordinary way, the appearance shown in Fig. b will be presented, and it will be seen that the wider lines have doubled in number, and, so far as definition is concerned, have become identical with the lower lines, the only possible mode of distinguishing them being by a slight decrease in light, which is necessarily caused by the partly opaque silver film in reality existing where the false lines appear.

We can carry this experiment a step farther, for better illustration of the effects produced, by again "tampering" with the spectra. If the object had consisted of lines twice as close as those of the lower set of Fig. I, the spectra would have been twice as far apart, that is, at the distance of the outermost ones of Fig. II (the space between them and the central beam being unoccupied).

This state of things can be produced artificially by cutting off all but the outermost spectra by the use of the diaphragm (Fig. C), and when that is done, instead of the two sets of wide and narrow lines, or two sets of equally distant ones (as in Figs. I and b), we have the wide ones quadrupled and the others doubled in number, so that the object presents the appearance of Fig. c, and, as in the previous case, no one seeing them would hesitate to affirm that the finer lines really existed.

This leads us to the application of Prof. Abbe's theory in the true explanation of angular aperture.

If, in the last experiment, the lines were still closer together, the spectra, now almost at the verge of the field, would have been thrown outside it altogether, and we should have had nothing but the central beam, with the same result as first shown, viz., the entire disappearance of all lines ; in other words, the object would not be "resolved" by an object-glass that would only take in the former spectra.

If, however, we had an object-glass of larger angular aperture, so that the spectra thrown outside the field of view in the former case

were now brought within it, the lines of the object would at once become visible, and the latter object-glass would have in ordinary parlance greater "resolving power" than the former.

The advantage, therefore, of an object-glass of large angle over one of smaller angle consists, in the case of objects with minute details, entirely in the fact that spectra, which with the one are thrown outside its field, are with the other brought within it, and thereby details of the object become visible.

We are consequently at once able to dispose, on the clearest grounds, of the controversy, raised a year or two back, as to the power of small-angled object-glasses to show the finest lines. Those who asserted such a fact were evidently (however unconsciously) drawing upon their imagination.

One other experiment may be mentioned as extending somewhat the ideas which the preceding ones enable us to form, and will be interesting to Microscopists as bearing upon the question of the structure of *P. angulatum*.

If an object is taken which is formed of two sets of lines placed over one another at right angles, we get of course a series of squares, as shown in Fig. III, which produces the spectra of Fig. IV.

It must be remembered (a point which I have not mentioned before, as its application is better seen here) that the spectra are always produced in a direction at right angles to that of the lines, as is seen in Figs. I and II, where the lines are vertical, whilst the spectra are horizontal. In the case of the cross lines we are now considering, the horizontal spectra are due to the vertical lines, and the vertical to the horizontal ones. So a line inclined at an angle of 45°—say, for instance, a diagonal drawn from the top left to the bottom right-hand corner of Fig. III, would produce spectra ranged in a line parallel to the other diagonal.

It will occur to you that these do actually exist in Fig. IV, and that, therefore, if we place at the back of the object-glass a diaphragm like Fig. D, only the spectra along the one diagonal will be admitted. When this is done, the rectangular lines entirely disappear, and are replaced by lines parallel to the other diagonal, as shown in Fig. d—a very striking example of the production of spectral lines. If the diaphragm had two slits at right angles, a second set of lines at right angles to the former would have appeared, forming a network smaller than the original ; so that, in lieu of the true object with vertical and horizontal lines, we should

have one in which the lines are oblique—a purely illusory appearance.

It results from similar experiments with these diffraction images that it is not possible to determine the real structure of *P. angulatum* merely from its image as presented by the microscope. With an object-glass of large angle, it appears, as is well known, to be covered with hexagonal markings, and when the diffraction spectra are examined, they are seen to be six in number, ranged round the margin of the field at equal distances, with the dioptric beam in the centre.

These hexagons are not, however, necessarily a true appearance, for some entirely dissimilar objects may be made to appear with hexagonal markings by cutting off all the spectra except the six just mentioned. Thus a set of lines, which, crossing one another at an angle of 60°, form in reality *rhombic* spaces, presents two rings of spectra—the inner one identical in position with that of *P. angulatum*. The rhombic spaces may be made to appear *hexagonal*, simply by reducing the aperture by a diaphragm, so as to exclude the outer and include only the inner ring. Or, again, by varying the combinations of the spectra, different sets of hexagons of varying size and position may be produced, all of which cannot, of course, represent the true structure.

It is thus seen that dissimilar structures give identical microscopic images, when the difference of their diffractive effects in the microscope is removed, and that, conversely, similar structures give dissimilar images, when their diffractive effects are made dissimilar, the moral of the whole being, as Prof. Abbe puts it, that minute structural details (as *striæ*, &c.) are not, as a rule, imaged by the microscope, geometrically or dioptrically, in accordance with the real detail of the object, and cannot be interpreted as morphological, but only as physical characters—not as *images* of material forms, but as *signs* of material differences of composition of the particles composing the object; so that nothing more can safely be inferred from the image as presented to the eye than the presence in the object of such structural peculiarities as will produce the particular diffraction phenomena on which the images depend.

In conclusion, I may mention that we are favoured to-night by the presence of Mr. Stephenson, the Treasurer of the Royal Microscopical Society, who first drew the attention of that Society to Professor Abbe's theory, and who has kindly come to exhibit, under the new oil-immersion objective (made on his suggestion at

Jena, and having an aperture exceeding that of a dry lens of 180° by no less than 25 per cent.), the object which excited much interest at their last meeting, viz., *P. angulatum* with the whole of the central dioptric beam stopped out, and shown by the diffraction images only. The hexagons have entirely disappeared, and are replaced by what look like round holes punched out of the groundwork of the valve—an appearance which, it is very interesting to observe, had, unknown to Mr. Stephenson, been previously calculated by a pupil of Professor Abbe, who had never seen *P. angulatum*, and to whom the problem was set as a pure mathematical and physical one ; his solution of it even takes into account a peculiar semi-transparency which the groundwork shows.

This experiment, I may mention, disposes of another fallacy that has its advocates, viz., that the central part of the objective is essential to fine definition.

In leaving the subject here, I think it will be admitted that it is a very important one, and it is not a little surprising that so few microscopists have hitherto appreciated its importance or the revolution it makes in microscopy.*

* A reference to this subject would be incomplete without a mention of Dr. Fripp, of Bristol, to whom the thanks of English microscopists are due, for having, at the cost of much labour, presented them with a translation of Prof. Abbe's original communication in addition to numerous papers of his own, written with the view of further elucidating the subject.

ADDRESS BY THE PRESIDENT,

Henry Lee, Esq., F.L.S., F.G.S., &c.

(Delivered at the Annual Meeting, July 26th, 1878.)

Gentlemen,—At the termination of my period of office you will expect that I shall offer to you a few valedictory remarks, to which I shall venture to add some brief suggestions. In my address last year I reviewed the progress of microscopical science, especially during the previous thirty-six years ; more, I think, with reference to the love of that science and a yearning for further knowledge having led to the foundation of the Quekett Club, than to any especial influence on the advancement of microscopy attributable to the club.

I claim for the Quekett Club that its members have contributed their full share towards microscopical researches, and to the invention of apparatus by which those researches are facilitated. But there is one branch of investigation to which I think increased attention may advantageously be given. We have had the microscope before us during the periodical meetings of the club in almost all its aspects except one, and that one has certainly not been developed to its fullest capacity. I allude to that which may be called "the commercial relations of the microscope."

The practical application of the microscope to the things of every-day life is something more than merely commercial microscopy. It is just that phase of microscopy which commends itself to the utilitarian, inasmuch as it furnishes a complete answer to the question, "What is the use of it?" As a rule, I have little respect for the mere utilitarian standard ; but, as so good an answer can be returned to the utilitarian questioner as to the utility of the microscope in a money-getting and money-spending world, let us be prepared to meet such an one on his own ground, and furnish a reply of the requisite kind. There are so many phases of this side of the subject that I shall not attempt to elaborate them. I beg you to understand that in mentioning a few I am only endeavouring to suggest a train of thought—not to compile a list of topics.

1st. The microscope is, and may be still more than it is now, a

useful instrument in the detection of crime and of criminals. Instances will occur to many of you of cases in which the microscope has been applied to stains of blood, to fragments of hair, and in other ways, with great success. A curious illustration of this will be found in a suggestion made in France, during last year, in order to prevent the forgery of bank-notes. There are some large toadstools, common everywhere in Europe, which are known by the scientific name of *Coprinus*. These, as they grow old and decay, melt into a black fluid of a permanent character, which has been used as ink. Under the microscope this fluid consists of uniform purple-black oval spores, which may be detected in the ink at any time after its use. The proposal in the "Bulletin de la Société Botanique de France" was to the effect that bank-notes should be printed or signed with this ink, which could always be verified under the microscope. I believe the obstacle to this was that there was no way known of manufacturing this coprin ink which forgers themselves could not employ.

2nd. The microscope may be useful in establishing innocence, as well as detecting crime. I had the great pleasure, some years ago, by means of the microscope, to save the reputation of an honest man, and prevent his being dismissed from a situation in which he had faithfully done his duty for many years. As, although I have frequently mentioned the incident in conversation, it has, I believe, never been published, I will record it here, as *apropos* to my subject. My deceased friend, Edward Blyth, the learned Indian zoologist, one day brought me a few fibres of fine hair, with an earnest request from a certain noble lord that I would, if possible, ascertain to what animal they had belonged. He was under a strict promise, he said, to give me no information, except that a matter of grave importance rested on my answer. Of course, I carefully examined the few fibres submitted to me, and was soon able to decide that, beyond a doubt, they were the hair and wool of a hare. I was enabled to arrive at this conclusion with the greater ease and certainty that I had just previously been engaged with "the microscope in its commercial relations," in minutely examining with a view to comparing their structure with their relative felting properties, the various furs used by hatters, amongst which is hare's wool. Poor Blyth was a very excitable man. When I told him my decision he shook my hand, and the tears rushed to his eyes, as he ejaculated "Thank God for that!" And then he danced about the

room, and gave way to so many exuberant expressions of delight that for a minute or two I could not obtain from him the explanation I was longing for. At length, he told me that a gamekeeper in the service of the nobleman referred to had been accused to his master of having been seen to trap a fox, cut it open, disembowel it, and carry it home with him to hide his misdeed. As vulpicide in a hunting country is regarded as an offence about as heinous as child-murder, the keeper would inevitably have been dismissed in disgrace if the charge had been proved against him. His story was that he had found a hare in a trap set by a poacher, whom he had deprived of his expected prize by taking it home for his own dinner, after paunching it on the spot ; and he added that the man who made the accusation was a troublesome poacher, and the owner of the trap, who had a spite against him because he kept a keen watch upon his movements. As the latter persisted in his accusation, the keeper's knife, with which he had opened the animal in question, was examined ; and, in the hinge of the blade, were found the hairs sent to me. My reply completely confirmed the keeper's statement, restored him to his master's confidence, and baffled the malignity of a scoundrel.

Two or three years ago an action at law came on for hearing in the North, in which a large field of onions having been blighted and destroyed, certain persons were sued for having caused the evil by the smoke of their neighbouring works. On the trial these damaged onions were produced, and proved to have been destroyed by a parasitic rust, which filled all the tissues of the plants, and killed them. The microscope gave an answer to the action, and the suit was lost.

Last year a similar trial took place in Edinburgh. A large number of evergreens and other trees were covered with a black coating like soot. It was assumed that this, also, was a case of smoke nuisance, and an action was commenced against the owners of certain chimneys. On the trial the report of our Foreign Secretary, Dr. M. C. Cooke, showed that the black substance was not soot, but organized vegetables—algæ and fungi—capable of germination ; and, again, the microscope prevailed. In both these instances had the simple precaution of microscopical examination been first employed large sums of money would have been saved by those who, having suffered supposed injury, attributed it ignorantly to the wrong cause, and experienced defeat.

3rd. The microscope is useful in protecting us against commercial frauds. Most of you are acquainted with Dr. Hassall's book on the adulteration of food ; and from it you will have learned how effective an instrument is the microscope in the detection of adulterations. A friend of mine, who is known to be a most indefatigable microscopist in the locality where he has resided for twenty years, called on his grocer for some article of domestic use—arrowroot, I think—and was astonished by being told by the tradesman that he had none to sell. He remarked, in surprise, that he had seen some weighed a few minutes previously. "True," said the grocer, "but I can't give *you* that—you are too handy with the microscope!" Not only in articles of food, but in clothing also is this protection afforded by the microscope. Some few years since one of our members, Mr. Suffolk, was engaged in a long series of experiments and examinations with the microscope and polariscope on the structure of flax, hemp, jute, cotton, and similar fibres. As a consequence, he was subsequently appealed to on more than one occasion to determine the character and extent of mixtures found in woven fabrics. Although this is an operation of great delicacy, when applied to fibres so similar in structure as jute and hemp, it is comparatively easy to detect the admixture of cotton with hemp, or of jute with silk.

4th. The microscope may be useful in the detection of concealed dangers to health. Some time since great consternation prevailed on the subject of trichinosis. All the evidence then adduced concerning the trichina encysted in diseased pork was founded on microscopical discovery. Instances might be multiplied, of course, of what has been done and what may be done to render the microscope valuable in commerce and in every-day life ; but I shall rest satisfied with having suggested thoughts which may be pursued at leisure. I fear that some of the elder members of our fraternity may consider my remarks somewhat elementary ; but it is my duty, as President of a Club like ours, to bear in mind that there are constantly joining our ranks recruits, to whom the microscope is new, and who have a right to expect guidance and assistance. That such incidents as I have mentioned could have occurred is sufficient proof that our Club, and other kindred Societies, may do good service by impressing upon public opinion the practical utility of the instrument from the use of which we derive so much intellectual enjoyment. In some quarters practical men are desirous of

enlisting the microscope in their service. I recently received a communication from the Manager of a large brewery, inquiring whether, and to what extent, the microscope might be expected to afford assistance in the operation of brewing. Some of the most formidable difficulties of a brewer are connected with the process of fermentation. This subject has had some little attention from workers with the microscope, and it is not surprising that, having learned this, manufacturers should ask us whether we can furnish them with any practical results. The acquisition of knowledge and the cultivation of science are delightful and beneficial of themselves, but, in my opinion, the highest object of science, and the greatest use of knowledge is that they be made practically advantageous and beneficial to mankind. It is this feeling which has suggested the tone of my remarks to-night.

Before I retire, there is one paramount duty incumbent upon me, and that is to thank you all for the hearty and cordial support which you have given me during my two years of office. It would not have been possible for the officers of the club, its committee, or the members generally, to have supported me more efficiently and kindly than they have done. Hence that which might have been two years of irksome and arduous duty has been to me, on the contrary, a period of pleasurable enjoyment. I need not recount the history of this period, but I trust that during the more brilliant career of my successors in the Presidency, we may be able to look back upon it with satisfaction, and that there may in the future be moments when we may revert with pleasure to incidents of the past two years. Like all its predecessors, this has been a season of harmony and unanimity of action, although not, of necessity, one of unanimity of opinions. As I first occupied this chair surrounded by all the evidences of good feeling, so, now, I leave it with the happy consciousness that there has not occurred one instance of dissension, discord, or schism, unfortunately but too common in large societies. It is no small honour to this club that throughout its career it has been conspicuously remarkable for the absence of party feeling and cliques. The good fellowship of the whole body of its members having been averse from this mischievous tendency has evidently been one of the causes of its unexampled success. We still remain, as we were ten years ago, *a club;* we still adhere to our old programme of sociable microscopy: and if the world has not been astonished by our great discoveries in science, it has, at

least, learned that five or six hundred persons can combine to cheer and strengthen and help each other in a favourite pursuit in perfect harmony, because thoroughly in earnest.

The best counsel that I can offer you on this last occasion of my addressing you from the chair is that you seek to maintain in the future the same features which have contributed to your success in the past; that you keep yourselves acquainted with the early history and development of your club; that you continue to bear in mind the objects and aims of those who first called it into existence; and that the original programme, which is always regarded by your officers and committee as their "Articles of Faith," be also your creed, and its principles be maintained by you as inviolable as a Royal Charter. I have seen the prosperity of societies diminished by imprudent changes in the conduct of their affairs; and, by the loss of their original tone, their warmest supporters estranged, their ardour damped, and their affections alienated. There appears to be no danger at present of any such mismanagement of our own club, therefore a word of warning may be the more freely given against such a contingency in the future. Do not be too anxious for innovations, alterations, new modes of action, or experiments which would involve any modification of the club, more or less change its character, and thus render it less fitted for the position it now occupies. From so large a body of members there will necessarily, from time to time, proceed suggestions and proposals inspired by the best intentions, and which will doubtless always receive patient and careful consideration. Let me urge you always to test them rigidly by the principles of your "charter," and ascertain whether they involve any departure from the original plan adopted by the founders of the club, and maintained by you during twelve years of its existence. If they do, reject them.

And now I have one duty left; it is to resign the office to which you did me the honour to elect me two years ago, to one far more competent than myself, and in whom we recognise all that we could desire in our President. I lay down my authority with supreme gratification that I am succeeded therein by one of the first spirits of the age, by one whom I have been accustomed to look up to with profound admiration and respect as a great master in science, whose name is known and revered wherever the English language is spoken.

I hoped that Professor Huxley would be here this evening, but before he was made aware of the date of our meeting he had

inevitably engaged himself elsewhere, and he wishes me to convey to you his apologies for his unavoidable absence. My respect for him and for you will lead me to regard it as an agreeable duty to be present at the meetings of the club during his term of office if my health permits ; that I may have the privilege of listening to his observations when he is able to preside, or that I may act as his substitute, in turn with my fellow vice-presidents, in his absence. In this I shall only be following the good example of my excellent predecessor, Dr. Matthews, to whom, separately and especially, I offer my grateful thanks for the kind and able support I have received from him.

PROCEEDINGS.

May 10th, 1878.—Conversational Meeting.

The following objects were exhibited:—

Filmy Fern	Mr. F. W. Andrew.
Raphides, *in situ*, in very young leaf of black bryony	Mr. T. H. Buffham.
Transverse Section of Fossil Wood from Coal	Mr. A. L. Corbett.
Larva of *Melöe cocatricosus*	Mr. F. Enock.
Ovary of Rabbit	Mr. W. H. Gilburt.
Eggs of Water-snail	Mr. W. Goodwin.
Feather from head of Wild Duck	Mr. A. H. Halley.
Parotid Gland of Kitten	Mr. J. J. Hunter.
Plocamium coccineum	Mr. A. D. Michael.
Meyerina claviformis...	Mr. B. W. Priest.
Section of Pearl	Mr. F. Reeve.
Daphnia	Mr. J. Woollett.

Attendance—Members, 62; Visitors, 5.

May 24th, 1878.—Ordinary Meeting.

Henry Lee, Esq., F.L.S., &c., President, *in the Chair*.

The minutes of the preceding meeting were read and confirmed.

The following gentlemen were balloted for and duly elected members of the Club:—Mr. F. E. Beddard, Major Richard O'Hara, Dr. W. T. King, Mr. A. Southey, and Mr. Horace Wilmer.

The following Donations to the Club were announced:—

"The Midland Naturalist"	from the Editor.
"Report and List of Bristol Natural History Society"...	„ the Society.
"Lindberg's Monographia Metzgeriæ" ...	„ the Author.
"Manual of Autographic Printing" ...	„ the Publisher.
"Report of the Hackney Microscopical Society"	„ the Society.
"The American Journal of Microscopy" ...	in exchange.
"Hartog on Floral Structure"	from the Author.
"The Medical Examiner" (weekly)... ...	„ the Editor.
"The Statist"	„ „

60 Drawings of *Hepaticæ* in portfolio ... „ Dr. M. C. Cooke.
A Solar Microscope, by Adams ... ... „ Mr. M. J. Hallett.
1 Slide, *Cheyletus flabellifer* ... ... „ Mr. Michael.
1 Photograph for the Album ... ... „ Mr. M. J. Hallett.

The thanks of the Club were unanimously voted to the donors.

A paper by Mr. Geo. Williams, "On an Apparatus for Facilitating the Use of Powell's Small Bull's-eye Illuminator for the Examination of Test Objects," was read by Mr. Curties (in the unavoidable absence of the author through indisposition). The subject was illustrated by diagrams, and by the exhibition of the apparatus in the room.

Mr. B. T. Lowne gave an interesting *résumé* of some of his recent researches on the structure of the eyes of insects, which had been lately made the subject of a communication to the Royal Society. Mr. Lowne commenced his remarks by observing that the eyes of insects were not only very pretty objects, but they were also objects of great interest, inasmuch as they appeared to have a very different manner of subserving vision from that of the eyes of ordinary Vertebrates. The most probable explanation of the manner in which vision is effected by the insect's eye was that given by Johannes Müller many years ago, and which had since been thought to have been entirely disproved by the production of the multiplied images of objects seen through the eyes in the manner which had been often shown in that room. He believed, however, that he should be able to show that in nine cases out of ten Johannes Müller's view was correct, and that many insects had no lenses at all in the cornea. Attention was next called to the work of Dr. Grenacher on this subject, and to the distinctive forms of insects' eyes which he had described. In his typical or conic eye there was found first a cornea, which might or might not be lenticular; then a body called the cone, consisting of eight distinct cells and formed of a glass-like structure of great transparency, from which proceeded some extremely fine fibres not exceeding the $\frac{1}{30000}$ of an inch in diameter. These fibres could be traced down into the retina, and they appeared to be formed of some semi-fluid material, seeing that when broken they ran up into viscid drops. Below the cone was a rod-like body which went down into the retina. Grenacher's next form was what he called the Pseudo-conic eye, and which was the kind found in the fly. This consisted of a lens, a cup containing a fluid resembling water, then a remarkable body consisting of four cells, and lastly a kind of rod connecting it with the retina. In addition to these he also found a third kind which he called the a-conic eye, and considered to be a rudimentary form, and one which probably remained so. Mr. Lowne then proceeded to examine these forms as described by Grenacher, and considered that there could be no doubt as to the existence of the conic eye. The Pseudo-conic form was that kind which used to be brought forward in opposition to Johannes Müller's view, and he had himself held to the same opinion at the time when he wrote his work on the Blow-fly. Since then, however, with improved means of investigation at his command, he had so far modified his opinion as to doubt whether it really differed much from the eyes of other insects, for he

found that at the bottom of the cup there were the four cells as in the others. He objected to the name, and proposed to call it instead the Hydro-conic eye, because it was found that although a cone existed in the eye of the pupa, its cells afterwards are replaced by fluid. In addition to these there was another form of eye which he believed no one except himself had pointed out. This form was then minutely explained by reference to a diagram; the cornea was said to be non-lenticular in shape, and the cone was described as consisting of four spherical bodies attached to delicate stems, which, in a modified form, passed down through the cup into the cornea. This structure was said to be found in all diurnal lepidoptera and in most of the grasshoppers. Another form of eye was then described by reference to a diagram, and shown to consist of a lens of very short focus, with a retina coming up close to it, the rods being all of a highly refractive nature, like rods of fine spun glass. Another form—found in Tipulæ, Gnats, Bees, and Wasps—had spherical lenses, with a bundle of sixteen rod-like structures, beneath each of which had a curious little bright globule attached to it. He thought it possible that these peculiarities of structure might be of use in perceiving other rays than those which we called light, and that nocturnal insects might be able to see objects by reason of their radiating heat.

The President said that at that somewhat late hour he would not encourage a long discussion, but would invite a few observations from any gentlemen present who might like to remark upon Mr. Lowne's very interesting communication.

Mr. Chas. Stewart said it was a long time since he had paid much attention to this subject, but he had listened with exceeding interest to Mr. Lowne's remarks, and hoped to reap considerable benefit from them, as he intended to look into some of these questions during the coming summer. As regarded the eyes of dipterous insects, he might say that instead of there being eight of the fibres he had in every case found the number to be seven. In a great number of them there was to be seen an exceedingly brilliant colouring in the eye itself, which rendered many of them such beautiful objects. Had Mr. Lowne any theory to explain this remarkable kind of tapetum? He believed he had found it to be due to a layer which existed between the individual lenses, and he fancied that it might have the same problematic value as the *tapetum lucidum* in some of the nocturnal animals. A pupillary orifice in some species had also, he believed, been clearly made out; some sections of spiders also led him to believe that there was little or no difference between their eyes and those of the insectidæ.

Mr. Lowne said with regard to the number of the rods, he had not stated the number as being at all precise. Four was, however, the typical number, but in a great many species seven were doubtless found, and it would be seen that they ran into one another and anastomosed in a very curious way. He had no doubt that what Mr. Stewart referred to was a true *tapetum lucidum*, and that there was yet a good deal to be made out of it. As regarded spiders he must confess that there were a good many in-

accuracies in Dr. Grenacher's paper, but still he thought there must be fluid found in some species; although not having investigated the subject, he could not say anything about it from his own experience.

The President proposed votes of thanks to Mr. Lowne and to Mr. Williams for their interesting communications, which were unanimously carried.

The proceedings then terminated by a conversazione, at which the following objects were exhibited:—

Platino-cyanide of Magnesium	Mr. F. W. Andrew.
Diatoms, *in situ*, on an *Alga*	Mr. T. H. Buffham.
Pulex masculi...	Mr. W. G. Cocks.
Section of Porcupine Quill	Mr. A. L. Corbett.
Trophi of Flea dissected by Mr. Tatem ...	Mr. T. Curties.
Wolf Spider, *Lycosa agretica*	Mr. F. Enock.
Argas reflexus	Mr. H. E. Freeman.
Globules of *Nitella flexilis*	Mr. W. H. Gilburt.
Young Water Snails	Mr. W. Goodwin.
Geranium Aphis	Mr. G. Green.
Eye of Insect...	Mr. A. H. Halley.
Water Spider	Mr. G. Hind.
Internal Dissections of Insects	Mr. J. J. Hunter.
Siphonia elastica, &c.	Mr. M. H. Johnson.
Cellularia cuspidata	Mr. T. S. Martin.
A New Rotifer	Mr. F. Oxley.
Microscopic Drawings	Mr. A. Hammond.
Fossil Sponge—*Siphonia multi-costata* ...	Mr. Priest.
Sherzolite from Pyrenees, &c.	Mr. G. J. Smith.
Medusa from *Corynæ*	Mr. T. C. White.
Toe of Mouse...	Mr. J. Woollett.

Attendance—Members, 71; Visitors, 4.

June 14th, 1878.—Conversational Meeting.

The following objects were exhibited:—

Leaf of Tea Plant	Mr. F. W. Andrew.
Pinnule of *Asplenium ad. nigrum*	Mr. T. H. Buffham.
Aulacodiscus Oreganus	Mr. C. G. Dunning.
Dolichopus popularis mounted without pressure	Mr. F. Enock.
Anatomy of *Cercopis sanguineolata* ...	Mr. F. Fitch.
Desmids	Mr. W. Goodwin.
Salivary Gland of Rat	Mr. J. J. Hunter.
Cyclops quadricornus...	Mr. T. S. Morten.
A New Rotifer	Mr. F. Oxley.
Hymeniacidon maceleuta	Mr. B. W. Priest.

Attendance—Members, 56; Visitors, 5.

June 28th, 1878.—Ordinary Meeting.

Henry Lee, Esq., F.L.S., &c., President, *in the Chair.*

The minutes of the preceding meeting were read and confirmed.

The following Donations to the Club were announced:—

"The Medical Examiner" (weekly) ...	from the Editor.
"Science Gossip"	„ the Publisher.
"The Analyst"	„ „
"The American Naturalist"	in exchange.
"Proceedings of the Academy of Natural Science, Philadelphia" (series extending over a period of five years) ...	from the Academy.
"Proceedings of the Belgian Microscopical Society"	„ the Society.
"Proceedings of the Royal Society" ...	„ „
"Proceedings of the Watford Natural History Society"	„ „
"Proceedings of the Geologists' Association"	„ the Association.
"Annals of Natural History"	by purchase.
"American Journal of Microscopy" ...	in exchange.
"Baker's Natural History of the Polyp" ...	from Mr. M. H. Johnson.
4 Slides of Polyzoa	„ Mr. A. D. Michael.
8 Slides of Flint Sections	„ Mr. Ingpen.
4 Slides of Sponges	„ Mr. J. G. Waller.
12 Slides	„ Mr. T. Curties.

The thanks of the meeting were unanimously voted to the donors.

The following gentlemen were balloted for and duly elected members of the Club:—Mr. W. Brewster, Prof. T. H. Huxley, Mr. John B. Magor, and Mr. Richard J. Ward.

The President reminded the members that as their next meeting would be the annual meeting, at which elections of officers for the ensuing year would take place, it would be necessary for them to proceed to nominate the gentlemen whose names would then be placed upon the list for ballot. The following nominations had been made by the Committee.—As President, Prof. T. H. Huxley, F.R.S., &c.; as Vice-Presidents, Dr. Matthews, Mr. Chas. Stewart, Mr. T. C. White, and Mr. Henry Lee; as Treasurer, Mr. Gay; as Hon. Secretary, Mr. J. E. Ingpen; as Hon. Secretary for Foreign Correspondence, Dr. M. C. Cooke.

The members were then requested by the President to nominate such of their number as they might desire to fill four vacancies upon the committee in place of Messrs. Johnson, Oxley, J. Smith, and Rogers, who would retire by rotation.

The following nominations were then made:—

Mr. E. T. Newton,	proposed by	Mr. Curties,	and seconded by	Mr. Gay.	
Mr. Frank Crisp	„	Mr. Lee	„	Mr. Oxley.	
Mr. A. D. Michael	„	Mr. Hailes	„	Mr. Freeman.	

Mr. F. Oxley	,,	Mr. Parsons	,,	Mr. T. Powell.
Mr. A. de S. Guimaraens		Mr. Crisp	,,	Mr. F. H. Ward.
Mr. E. Simpson	,,	Mr. Terry	,,	Mr. F. H. P. Hind.

The President announced that Mr. Hainworth had been appointed auditor of the accounts by the committee, and requested the appointment of another gentleman to act in that capacity on behalf of the members.

Mr. Dobson was then proposed by Mr. Curties, seconded by Mr. Cottam, and elected in the usual manner.

Mr. Frank Crisp then read a paper "On the Influence of Diffraction in Microscopic Vision," the subject being well illustrated by excellent coloured diagrams, and by objects and apparatus exhibited in the room, special attention being called to the exhibition of *Pleurosigma angulatum* by Mr. J. W. Stephenson with the new oil-immersion lens, and with the central dioptric ray stopped out so as to produce an image formed by diffraction spectra only.

Mr. J. W. Stephenson, in reply to the President, said that Mr. Crisp had so completely exhausted the subject that he hardly knew if he could add anything to what had been said, except to point out that the experiment which he proposed to show with *P. angulatum* was merely the exclusion of the central dioptric beam, and that the effect of this was that the markings were shown as bright circular dots punched out of a beautiful blue ground. If every alternate spectrum was stopped out then hexagonal markings were seen. With the oil lens the angle was so large that it took in spectra of the second order.

Mr. Curties enquired if the appearance shown was to be considered as the correct view of the object?

Mr. Stephenson said they did not know what *was* the correct view.

Mr. Ingpen said that what Mr. Crisp had brought forward as the rudiments of this subject formed the groundwork of the knowledge of a branch of microscopy which was of very great importance, and it was just in this way that one should bring forward the first principles of a matter which every one would agree ought to be well known, and could not be too widely or thoroughly understood. And he might add that he hoped the subject would be followed up not only by the members themselves, but also that further instruction might be given at suitable times of the application of the principles involved. As soon as the principles were explained in a paper, the subject became educational, and there was then great scope for explaining these applications to the members of the Club, to whom it could be shown how great was the advance thus made both in the theory and practice of the microscope.

Mr. Frank Crisp briefly, by means of drawings upon the black board, showed how the intersection of three sets of lines naturally produced the appearance of hexagonal markings.

The President then proposed a vote of thanks to Mr. Crisp for his excellent paper, and also to Mr. Stephenson for his kindness in coming down that evening to illustrate it. Carried by acclamation.

Announcements of meetings and excursions for the ensuing month were

then made, and the proceedings terminated with the usual conversazione, at which the following objects were exhibited:—

Double-stained Vegetable Tissues	Mr. Curties.
Soldier Beetle (*Telephorus melanurus*) ...	Mr. Enock.
Foot of Human Fœtus	Mr. J. J. Hunter.
Sections of Leaf of Irish Yew	Mr. W. H. Gilburt.
Syenite, &c.	Mr. G. J. Smith.

Also specially in illustration of Mr. F. Crisp's paper, objects and apparatus were exhibited by Mr. Crisp, Mr. Curties, Mr. Ingpen, and Mr. J. W. Stephenson.

Attendance—Members, 54; Visitors, 2.

July 12th, 1878.—Conversational Meeting.

The following objects were exhibited:—

Hairs of the Tea Plant	Mr. F. W. Andrew.
Head and Tongue of Sand Wasp (*Cerceris arenaria*), mounted without pressure	Mr. F. Enock.
Growing-point of *Dahlia*	Mr. W. H. Gilburt.
Damœus papillipes	Mr. A. D. Michael.
Æcidium urtîca, Nettle cluster cups ...	Mr. H. J. Roper.
Section of Ovary of Mallow	Mr. J. Slade.
Section of Stem of *Gallium aparine* ...	Mr. F. H. Ward.
,, ,, *Stachys sylvatica* ...	,,
,, ,, *Scrofularia nodus* ...	,,
,, ,, Strawberry	,,
,, ,, *Gladiolus*	,,
Section of Petiole of Parsnip	,,
Young *Hippocampus* (alive)	Mr. T. C. White.

Attendance—Members, 35; Visitors, 5.

July 26th, 1878.—Annual Meeting.

Henry Lee, Esq., F.L.S., &c., President, *in the Chair.*

The minutes of the preceding meeting were read and confirmed.

The following gentlemen were balloted for and duly elected members of the Club:—Mr. John Battersby, Mr. William Crockford, Dr. John McDonald, and Mr. Henry Morland.

Two gentlemen were proposed for membership.

The following donations to the Club were announced:—

"The Popular Science Review"	from the Publisher.
"Science Gossip"	,, ,,
"Journal of the Royal Microscopical Society"	,, the Society.

"The Medical Examiner" (weekly) ...	„ the Editor.
"Proceedings of the Belgian Natural History Society"	„ the Society.
"The American Journal of Microscopy" ...	in exchange.
"Annals of Natural History"	purchased.
A New Micrometer on the principle recently described by Mr. Burch ...	from Mr. Curties.
Some old Slides mounted in ivory slips between Mica, for the Museum.	Mr. B. W. Priest.

Portraits for the Album of Mr. M. H. Johnson and Mr. T. C. White.

The thanks of the meeting were unanimously voted to the donors.

The Secretary read the Annual Report of the Committee.

The President said that having heard the report, he rose to formally move that it be adopted and printed in the usual way. He called attention to the reference which had been made to the donation of £20, which it had been decided to give to the building fund of University College, and which he felt sure would meet with the hearty approval of all present, seeing how largely they were indebted to the Council of the College for permission to meet in that room—a privilege which, no doubt, had greatly contributed towards the remarkable success of the Club.

The adoption of the report having been seconded by Mr. T. C. White, was put to the meeting, and carried unanimously.

The Report of the Treasurer containing balance-sheet, &c., duly audited, was then read by the Secretary.

The President moved "That this report be also received, adopted, and circulated with that of the Committee."

Mr. T. C. White having seconded the motion, it was put to the meeting, and unanimously carried.

Mr. Reeves and Mr. Faulkner having been appointed scrutineers, the ballot papers were distributed, and the election of officers proceeded with.

The President then delivered the customary Annual Address, taking for his subject "The Commercial Application of the Microscope," and concluding his remarks by many useful suggestions and counsels to the members as to their future wellbeing as a Club, and by the expression of his thanks to those who had so ably and unanimously co-operated with him in the conduct of its affairs during his two years term of office.

The Address was listened to with great interest and attention, and loudly cheered at its conclusion.

Dr. M. C. Cooke said that the pleasure with which he had listened to the very interesting address of their worthy President, led him to rise and ask the members to support him in proposing that the Address be printed and circulated with the Journal in the usual manner. He did so with great pleasure, because he was so fully aware how their President had worked for the wellbeing of the Club, and how heartily he had promoted its interests in every way in his power.

Dr. Matthews seconded the proposal with entire satisfaction.

Mr. Ingpen said that he had the greatest pleasure in supporting this

proposal, and as the President could not himself put it to the meeting he would do so. Having put the resolution to the meeting, it was carried by acclamation.

Mr. J. G. Waller said the task had been committed to him of proposing a vote of thanks to the President, Committee, and Officers of the Society, for their services during the past year. As regarded the President, Dr. Cooke had already taken the words out of his mouth, and he could add nothing which more entirely expressed his own appreciation of his merits. Their Secretary was one whose labours were too well known to need any observations from him. The other officers well deserved the thanks of the Club, and the Committee had always performed their duties in an admirable manner, and he had very great pleasure in moving this vote of thanks to them for their labours.

The motion having been seconded, was put to the meeting, and carried unanimously.

The President said he could not forbear again expressing his appreciation of the work done by their esteemed Honorary Secretary—so painstaking, so punctual, so reliable, so business like, his services were of no common kind. He felt he must thank him personally for the assistance he had received from him during his period of office, and for the promise to continue to act as their Secretary to the end of his term, although intimation had been given of his strong desire to resign. He was also glad to be able to announce that Mr. Ingpen had consented to continue his duties as secretary to the end of Professor Huxley's term of office as their President.

The President then moved the thanks of the Club to the Council of University College for the continued privilege of meeting in the library of that building. He was sure that every member who was in the habit of coming there must feel grateful to the Council for their kindness in this matter.

The motion was carried by acclamation.

Mr. T. C. White said he had a pleasing duty to perform in proposing a vote of thanks to the auditors and scrutineers for their services in connection with the accounts and the ballot.

Dr. Matthews having seconded the motion, it was put to the meeting and carried unanimously.

The President said there was one other person to whom they owed a good deal—in a quiet corner next the Secretary sat Mr. Lewis, their honorary reporter, who from the first had carried on his work without emolument or remuneration, and this so quietly that perhaps there were many amongst the members who were not even aware of it. They all thought, however, that the time had come when they might and would offer him some token of their thanks, and as they felt that it would not be in accordance with his wishes that they should draw upon the funds of the Club for this purpose, the Committee and a number of the members had joined together in the matter, and he now had the pleasure of presenting to Mr. Lewis a testimonial of their feelings towards him in the form of a gold watch, which he asked him to accept in their name, and to wear as a token of their esteem for the service which he had thus for so many years rendered to the Club. The President then handed to Mr. Lewis a valuable gold watch, the case of

which was beautifully engraved with his monogram, and inside which was also engraved the following inscription :—" Presented to Mr. R. T. Lewis by some of his fellow members of the Quekett Microscopical Club, in appreciation of his services as honorary Reporter. July 26th, 1878."

Mr. R. T. Lewis expressed his warm thanks to the President and to those gentlemen who had been associated with him, not only for the very handsome testimonial which had been placed in his hands, but also for the very kind way in which the presentation had been made. He was extremely glad to have been able to perform any service to the Club, and his position might be explained by a reference to how he came to undertake it in the first instance. The idea was started at the meeting of the Club in October 1866, when a gentleman to whom they had so often been indebted for useful suggestions, Mr. (now Dr.) M. C. Cooke, expressed his opinion that the meetings of the Club were becoming so important that some permanent record of them was very desirable, and he hoped some member would be moved to volunteer his services in that direction. Accordingly during the following week he (Mr. Lewis) wrote to their then Secretary, Mr. Bywater, and offered to do what he could in the matter, stating that he did so from the desire to be a useful rather than a useless member of the Club. With this wish he had all along been animated, and he hoped, if spared to continue the work, he might be yet able to do so for many years to come, being desirous to do what he could for the welfare of the Club, whose interests he had so much at heart. It had been a labour of love, and, thanks to the extreme kindness which he had always experienced from the three Secretarys with whom he had had the pleasure of working, it had never at any time pressed upon him as a burden, indeed from first to last the only cause he had for regret was that having one evening carelessly left one of his report books in a carriage in the Underground Railway, no amount of enquiry or offered reward sufficed to get it restored. He again sincerely returned his thanks for the very beautiful present which they had made to him ; he should value it for its own sake, but should do so far more as an expression of the good feeling of those many friends by whom he felt himself surrounded.

The Scrutineers having handed in their report, the result of the ballot for officers and Council was declared to be as follows :—

As President	Prof. T. H. Huxley, F.R.S., &c.
As Vice-Presidents ...	Mr. Henry Lee, F.L.S., F.R.M.S., &c. Dr. J. Matthews, F.R.M.S. Mr. C. Stewart, M.R.C.S., &c. Mr. T. C. White, M.R.C.S., &c.
To fill four vacancies on the Committee ...	Mr. F. Crisp, B.A., LL.B. Mr. A. D. Michael, F.R.M.S. Mr. E. T. Newton, F.G.S. Mr. F. Oxley.
As Hon. Treasurer ...	Mr. F. W. Gay, F.R.M.S.
As Hon. Secretary ...	Mr. J. E. Ingpen, F.R.M.S.
As Hon. Foreign Secretary	Dr. M. C. Cooke, M.A., A.L.S., &c.

The Secretary said that a paper had just been handed in which would be interesting as showing the results of one of their latest excursions—that of July 13th to Hampton Court. The water there was productive of a number of the most valued and beautiful microscopical objects. The excursion had been highly successful. He then read the following list (which had been prepared by Mr. Oxley) of the principal objects found on that occasion :—

POLYZOA—*Cristatella mucedo, Plumatella repens.*
ROTIFERA—*Melicerta ringens, Limnias ceratophylli, Æcistis crystallinus, Lacinularia socialis, Floscularia cornuta*, &c., &c.
INFUSORIA—*Acineta, Ophrydium, Anthophysa Müllеri, Arcella vulgaris.*
Hydra vulgaris (very large specimen), &c.

Dr. M. C. Cooke said that on occasions like that when they caught any live object, especially one from a far distant place, they liked just to stick a pin through him, and exhibit him to the meeting. They had with them that evening a friend of his from the Far West, a member of the San Francisco Microscopical Society, and he wanted him to be able to go back and say to his brethren on the other side of the Atlantic that he had attended the annual meeting of the Quekett Microscopical Club, and that the members present heartily sent their greeting to their fellow-workers in that distant land.

The President expressed the pleasure which he felt at seeing his friend Dr. Harkness amongst them as a visitor upon that occasion, and in the name of the members assured him of the hearty good wishes felt by all of them for the welfare and prosperity of the Society with which he was connected.

Dr. Harkness said that he felt much gratified at this compliment, and should upon his return home convey to his co-workers an account of the reception he had met with from the meeting.

The proceedings then terminated with a conversazione, at which the following objects were exhibited :—

"Beetle found in Old Furniture"	Mr. F. W. Andrew.
Cristatella mucedo, &c.	Mr. Cocks.
Abdomen of Wild Bee, containing Male and Female *Stylops Spencii* ...	Mr. F. Enock.
Cheyletus (alive)	Mr H. E. Freeman.
Trichinæ (*in situ*)	Mr. J. J. Hunter.

Attendance—Members, 80 ; Visitors, 11.

On the History and Structure of Corals.

By John Matthews, M.D., F.R.M.S.

Read September 27, 1878.

PLATE VIII.

I have a few words to say by way of preface to the subject on which I am to address you this evening, and, if they appear to you to be somewhat egotistical, I ask you to believe that they seem to me to be absolutely necessary thus far, that I am able, in that way only, to set clearly before you the *raison d'être* of this paper, and, therefore, to excuse me.

I have ever held strict mutuality to be one of the most indispensable conditions of fellowship of this as well as of kindred societies. It is not enough that a man merely become a member. By doing so, he not only acquires certain privileges and advantages which he can scarcely rate too highly, but he—*ipso facto*—takes on himself correlative duties, the former immediate, the latter most probably postponed—deferred—until he shall have passed his novitiate. His privileges are, to see, to hear, to observe, to question, and the more he exercises this last, the better for him. In due time, it is incumbent on him to impart what he knows freely, to help by example, by lucid direction, by patient reply. It must be quite obvious to all who have long been members of this Club, that our conversational meetings have done much to promote its prosperity, not only by the friendly intercourse, which is the natural result, but by the tacit obligation which they seem to enforce—that it is each member's duty to contribute in his turn, as often as he can, to the interest or instruction of the evening.

It is an uneasy feeling of shortcoming on my own part in this respect, as well as another motive not less powerful, and which I will explain presently, that is the origin of this paper.

Our field excursions are undoubtedly of the utmost value as feeders and promoters of search for the necessary objects for display and discussion on the gossip nights—or ought to be ; but it is cer-

tainly very quietly and below the surface—if I may use such an expression. I cannot help thinking that their results ought to appear more frequently in the shape of papers and discussions in our transactions, to which they would impart an unfading interest and value. And now, in relation to my own share of the exchange on which I have laid so much stress, I must aver that it has ever been a cause of much regret to me that the excursions take place on a day of the week which my professional duties forbid my using for that purpose. My opportunities for the pursuit of Natural History are thus very rare. It is an almost trite saying, "that a medical man's work is never done," so that, as I very rarely know when I shall have a leisure afternoon, I cannot arrange to have the company of a friend, and thus such excursions are neither so pleasant nor so profitable as if I had the society and ready aid of some of the gentlemen whom I now see before me. To a great degree, then, I am compelled to rely upon my vacations, alas ! too few and far between ! Yet, out of them, I do manage to get work for a few months after, as you shall now hear.

Some three months or more ago, I paid a visit to Llangollen. On a mantel-piece at the house of my friend there, whose wife is an ardent naturalist, an obelisk, fashioned out of what appeared to be black marble, attracted my notice, as it was evidently full of organic remains. On enquiry, I was informed that the stone came from a quarry near Corwen, a town west of Llangollen. Of course, I went there as soon as possible, and found that the formation was full of fossils, and presented features of the highest interest. I may also tell you that there is a range of lofty limestone cliffs, which I visited, called the Eglwyseg Rocks to the north of Llangollen, running parallel with the beautiful vale, and from two to three miles long, which has been extensively quarried, and is, therefore, easily open to inspection. This also abounds with similar fossils, of which I subjoin a list, furnished to me, by a local authority, and corrected by Mr. Newton of our club :—

Corals (Cœlenterata.)

Lonsdaleia	*(species of)*
Lithostrotion	*irregulare.*
,,	*basaltiforme.*
Syringopora	*juncea.*
,,	*reticulata.*

POLYZOA.

Fenestella nodulosa.

BRACHIOPODA.

Productus Llangollensis.
,, *giganteus.*
,, *spinulosus.*
Spirifera (species of)
Terebratula hastata.
,, *(? Spirifera) glabra.*

I brought some of my precious specimens home with me, being much pleased with the opportunity of being able to contribute by their help to the interest of our meetings. Having no means of ready access to the necessary Geological authorities or text books at the time, I was glad to be able to avail myself of the help of Mr. Newton, who pronounced them to be fossil Corals, and also kindly took the trouble to identify and name them for me. I had not then been able to examine their structure, but our members may recollect that I displayed some sections, which had been very nicely made by Mr. Smith, on our Gossip night, August 9th.

Well, they were *Corals*. But I began to ask myself: What is a *Coral?* What do I know about Corals? Of course I had a *general* knowledge of them, but I was compelled to confess to myself that it was of a very hazy kind. Something I knew, certainly, of their structure and zoological place, but it was not all of a precise kind, nor such as I could—in default of the necessary precision—easily and honestly communicate to others, and I was far from being content with it. I then began to use my privilege of "Socratic questioning"—only to find that many of my friends were in very much the same condition as myself. A little more egotism, Gentlemen, and I have done. When I was a young man, my reading was not well directed—it was far too promiscuous and desultory. I was omnivorous, in fact. Much of the information thus gathered has clung to me—not always of the most useful kind, I fear. Still more has slipped away—alas! of the more useful. Yet, all has not gone. I have now in my mind, stored there for more years than I care to remember, the substance of a paper which is to be found in one of the best of our English classics—the "Spectator." I am tempted to quote it to you now, because it embodies and insists upon that recognition of the labour of others, which I have taken

occasion to urge, in one of the addresses which I have had the honour of delivering in this place.

It runs thus : You probably all recollect the good old knight, Sir Roger de Coverley? Indeed you ought all to know him well. He has a domestic chaplain, whom he has made the parson of the parish. He had, " being afraid of being insulted with Greek and Latin at his own table . . . desired an old friend of his to find him out a clergyman, rather of plain sense than much learning, of a good aspect, a clear voice, a sociable temper, and, if possible, a man that understood a little of backgammon."

He proceeds to say—" At his first settling with me, I made him a present of all the good sermons (both by living and dead authors) that have been printed in English, and only begged of him that every Sunday he would pronounce one of them in the pulpit. Accordingly he has digested them into such a series that they follow one another naturally, and make a continuous system of practical Divinity." He continues—*i.e.*, the 'Spectator'—not Sir Roger :—

" I could heartily wish that more of our country clergy would follow his example . . . and would thus enforce what has been penned by greater masters. This would not only be more easy to themselves, but more edifying to the people."

This, Gentlemen, is the second motive to which I just now referred, and, heartily coinciding as I do with the principle so genially laid down by the " Spectator," feel that it is equally applicable to the works of the great writers on Natural Science. I do not, however, propose to follow it literally on the present occasion, except so far as to endeavour to make you fairly well acquainted, as well as myself, with some part of the literature of the very fascinating subject now before us.

Men who have been labouring hard in their daily avocations often dislike the labour of reading, and yet the mind though needing rest, is at least receptive ; I therefore venture to think that they will gladly listen to any one who will narrate to them, or at least set before them in some lucid way, an account of the labours of our masters in science as occasion may suggest.

What I have done, then, and propose to do in the future—if the effort prove successful and acceptable to you—is to collect and collate, as succinctly as I can, all that I can gather on a given subject, together with such additions of my own as I may have been

fortunate enough to make. We *must* avail ourselves of the labours of others—or what would be the use of books? What would the mechanical engineer do without his tables of strength of materials! What the civil engineer without his constants—all of them the results of the labours of their predecessors? And, if we be taller than our fathers, is it not because we are hoisted on their shoulders?

In this spirit, therefore, I now propose to lay before you a brief account of Corals.

1st. *Their history—ancient and modern.*
2nd. *Their place and analogies in zoology.*
3rd. *Their structure—development—modes of offence and defence, and their works.**

The time at my disposal will not admit of more than a sketch—yet I hope a trustworthy one, of a very large subject.

A very fanciful origin has been found for the word Coral, by which it was said to have been derived from two Latin words—"*Cor*"=*the heart*; "*alere*"=*to nourish*. This idea is a relic of very curious old medical theory, which has long disappeared under the light of modern science, called the doctrine of *Signatures*. Under it most natural substances were imagined to possess some indications of their medical properties and uses, called "Signatures"—from "signum," Latin for a mark or sign—either by some fancied resemblance of shape or colour between them and the bodily organism, or by some peculiar taste or odour in the case of plants, and these were supposed to arise from astral influences. In the present case the fancied resemblance of red branching Coral to the heart and bloodvessels was thus supposed to indicate its uses in medicine, and hence its name. There are many relics of this old theory in the domestic as well as the classical names of herbs which were largely used in ancient pharmacy. But there can be no doubt that the real derivation is from two Greek words, which mean κόρη "*Daughter*;" ἁλὸς "*of the Sea*." The name "Coral" thus becomes singularly appropriate. The ancients did not know much of any Coral but the red variety, since that was the kind which was found most plentifully near their great centres of civilisation, and they prized it greatly, adorning with it their helmets,

* Commonly so called, but which are only the normal results of their life—their skeletons, in fact.

shields, and weapons. They wore it made into amulets to avert the "evil eye," and necklaces of it placed around the necks of new-born children were supposed to preserve them from contagious diseases, of which practice a relic still exists in the shape of *the baby's coral and bells*. It is found in many parts of the Mediterranean Sea, principally at the entrance of the Adriatic Gulf, the Ægean Sea, and on the coasts of France, Barbary, and Tunis. It is got up by a rude kind of dredge sometimes, but very rarely from water only ten feet deep, but is never found below 150 fathoms, generally at between about 60 to 100. That found in the Adriatic and on the coast of France is of the most brilliant colour, but in commerce there are five varieties, of which the rose-coloured is the most rare and valuable.* Of its modern uses I need not speak.

The Corals belong to the Cœlenterata, the general characters of which are, that they have a distinct and permanent mouth, and a distinct and permanent body-cavity, but the mouth opens into, and freely communicates with the body cavity either directly or indirectly. The Cœlenterata are divided into two classes—the *Hydrozoa* and the *Actinozoa*, and amongst both probably are found the Corals. The type of the former is the fresh-water *Hydra*, that of the latter, *the Actinia, or Sea Anemone.* The Hydra consists of a soft muscular bag, capable of being stretched into a slender tube, shrunk into a small globe, or widely distended, at will. At one end there is a circular mouth, highly sensitive, opening, closing, or protruding like a cone, and surrounded by from five to twelve (according to species) long and flexible *tentacles*, arranged symmetrically. The mouth opens into a cavity, which extends throughout the length of the body, and performs the office of a stomach ; but it is stated, as an extraordinary fact, which at present needs confirmation, that they appear to suffer no inconvenience from being turned inside out, the new cavity performing all the functions of digestion as well as the old one. The other end terminates in a disc-like sucker, by which the *Hydra* fixes itself to aquatic plants. The whole sac, or bag, forming the body is made up of three layers, the *Ecto-derm*, the *Meso-derm* more or less developed, and the *Endo-derm*, and the space between is filled, according to my own observation, with a semi-fluid matter, having in it some apparently solid bodies and vacuoles, or apparently empty spaces. These

* It is said by Mrs. Somerville that the white variety is a diseased form.

layers are united at the mouth, and each tentacle consists of a prolongation of the layers of the body, enclosing a branch of the stomach, and having many stinging or thread cells. No *hard* skin layer is ever at any time developed in the Hydræ. In none of them is there a hæmal or blood system, nor a neural or nerve system, and aëration is effected by contact of the whole surface with the water in which they live.

These creatures increase by budding, like plants. They are also hermaphrodite, being alternately propagated by buds and by eggs according to the season of the year. Dr. Carpenter says that this process of budding must be regarded as a modification of the ordinary nutritious process like the power of reparation so remarkable in all animals, but which exist in greatest degree among the lowest tribes, and especially in the Hydra, which may be cut into pieces, each part becoming a perfect animal.

The Hydrozoa, then, may be defined shortly as those cœlenterata in which the walls of the digestive cavity are not separated from those of the general body cavity, the two coinciding ; and the reproductive organs are in the form of external processes of the body, wall buds, in fact, on the one hand, or, of external protuberances, containing either spermatozoa, at the base of the tentacles, or ova, which appear in autumn towards the base of the column, forming a connecting link between gemmation, and ordinary sexual generation.

The Actinozoa differ from the Hydrozoa in this important respect that they have a space between the digestive cavity and the general body cavity, *i.e.*, the cavity bounded by the outside of the animal, so that it resembles a vessel suspended in another by an upper turned-over edge, like a double glue-pot, the inner vessel having a hole below, by which it communicates with the cavity of the outer. The great family of Actinian Zoophytes, or Anthozoa, numbers many genera and species. The common sea anemone is the type of all such of them as inhabit the stony corals, and build the coral reefs and atolls of the tropical Pacific, they being essentially the same in structure, but having no sucking disc at the base. The sea anemone has a cylindrical body, attached at one end by a sucker to rocks ; at the other end is also a disc, more or less concave, having a mouth in its centre. This is usually elongated in one direction, and at the extremity of the long diameter are folds which are continued into the gastric cavity. It is surrounded by a series of tentacles, which vary considerably in number, but are generally in

multiples of five or six, and are tubular, usually retractile, smooth, generally more or less conical, but sometimes thread-like, and mostly richly coloured. You must all be familiar with these beautiful flower-animals, so that I need not say more about their external appearance.

The soft smooth body consists of three layers—an outer (Ecto-derm), inner (Endo-derm), and intermediate, more or less largely developed (Meso-derm). It is provided with two layers of muscles, probably developed in the meso-derm, the fibres of which are antagonising, being longitudinal and circular.

From the edge of the mouth is suspended a bag, which is the stomach. This has an opening at its lower end, by which its cavity communicates freely with the body cavity. Between the two are a number of thin partitions or folds, called *Mesenteries*, which connect them—some completely, others not—forming many interspaces, called *loculi*, and inter-communicating freely, their number and that of the tentacles generally corresponding, and the latter also opening at their bases into these interspaces. All these cavities are lined with innumerable cilia, which keep up a constant circulation in the water which is admitted by the stomach into the whole animal, and which thus effect *respiration*, and, being mixed with the digested food, *nutrition* also.

In these creatures, as in the Hydræ, reproduction is "concurrent"—*i.e.*, it may be effected in the same organism by ovulation, or by gemmation, or by fission, which last seems to be the origin of the laminated forms of Corals which thus grow laterally. But there is this important difference between them—that in the Hydræ it is wholly external, as I have before said, but in the Actiniae and the Coral polyps, while the individual is multiplied by buds, the species is multiplied by *sperm* and *germ* elements. The situation in which these elements occur, and their mode of conjunction, are somewhat peculiar in this tribe. They may be hermaphrodite, but generally *spermatozoa* are developed in cysts in the mesenterics of the *males*, and when perfect are discharged into the stomach, whence they are at once ejected by the mouth into the water. In like manner the *ova* are first observed in the mesenteric folds of the *female*, and when mature are discharged into that cavity, which also receives the *spermatozoa* imbibed with the food. Very few things are more wonderful to me than this circumstance, that *the ovum remains in the stomach, after having been*

impregnated, until it is hatched, and the progeny, a pear-shaped ciliated embryon, is discharged into the water by the mouth. Why is it not dissolved with the food? There is one other part of the organism of these creatures which I must now notice briefly, viz., their *thread cells*, which are endowed with the most marvellous stinging powers, and from which the Acalephæ take their name. With the exception of some of these, the thread cells of the sea anemone are more highly developed than in other animals of the class. During the act of contraction on being touched, a number of long filaments called Craspeda (fringes) issue through the walls of the body by almost imperceptible slits, with a stream of water from the chambers. These are covered with the poisonous stinging cells, by which the creature touched or entangled in them is paralysed and rendered an easy prey. I call your special attention to these as interesting objects for microscopical examination and display. It is easy for you now to understand how the stony Corals and Madrepores are formed. The Coral polypes have the power of abstracting carbonate of lime from the sea-water, combined with a little animal matter, and a still smaller quantity of phosphate and sulphate of lime, with a trace of silver and magnesia. This stony substance takes the form of needles, a network is formed around the body of the animal, which, by a series of these deposits, is condensed into a hard impervious coat. The same process goes on simultaneously in the mesenteric plates near their bases, and in many of the Corals a horny column forms in the axis of the Polype, called the *Columella*, which is soon hardened by calcareous deposit, and varies in structure in different genera. The horizontal septa which are to be seen more or less in all Corals, crossing the mesenteric plates—some of them at varying depths in each of the loculi, and called tabulæ and dissepimenta—are evidences of the growth of the tenant upwards, since having left that part it has no longer any use for the space, and therefore cuts it off by a partition. Thus, the Actinious polypes may be said to possess an internal skeleton, and they also acquire an external one, in the form of a cylindrical coat, into which most of them can withdraw the soft upper part of their bodies and tentacles. The plates are sometimes continued through the wall, forming ribs, which project, but are still covered by the ectoderm. By far the greatest number of Corals grow in size by budding, as the Astræa, one of the deepest. They form groups in which the whole of the polypes, except their

starry summits, are connected by a living viscous substance, called Cænosarc, which, becoming consolidated by lime taken from the sea water, becomes what is called Cœnenchyma, or Sclerenchyma, so that the resulting Coral becomes a rounded mass, yet varying in shape according to the genus or species. The variety of compact or branching Corals far exceeds description, one hundred and twenty species being inhabitants of the Red Sea alone.

The *Millepora complanata*, which, according to Mr. Moseley, of the "Challenger," is one of the *Hydrozoa*, is the largest coral known. This and the Porites, and one or two others, are the chief reef-building corals. They cannot live at greater depths than from 15 to 25 fathoms, for light and abundance of air are essential, and these decrease as the depth increases. In every case the polypes are alive only as far as they have free access to light, heat, and air contained in the water. The process of budding kills them also, for, when the buds proceed from the discs, or cups, of the star (*i.e.*, are cæspitose), the consequence is the death of the parent, and the formation of a new layer of the living above the dead. They thus increase vertically. Red coral was for a long time regarded as a marine plant, but is now well known to belong to a group of polypes called Alcyonaria, of which *Alcyonium digitatum*, an octo-corallum of Huxley, may be taken as the type. Its polypes possess eight fringed tentacles. If they possess sheaths, or cases, they are without horizontal septa or partitions. The mesenteries and body chamber are in fours, or multiples of four. And the corallum, if any, is sclero-basic, a term which I will explain presently, and they have abundant spicules in the sarcode. They are divided into Alcyonidæ, Tubiporidæ (organ corals), Pennatulidæ (which include the sea pens, sea fans, cock's combs, etc.), and lastly the Gorgonidæ, to which the red coral of commerce belongs.

I have now to set before you, as clearly as I can, the nature of the difference between this group and the reef-building corals, and to do this intelligibly, I must recall your attention to the three coverings of the Actiniæ and Hydrozoa, viz., the *Ecto-derm*, the *Meso-derm*, and the *Endo-derm*, as, upon the development of the corallum (for so the hard structure of the corals is called) in each of these is founded their classification.

In the reef-building varieties, and in many others of the branching kind, the hard structure is formed within the *Meso-derm*, and

in the intercellular substance of that layer of the body, and also of the mesenteric partitions, which form the loculi. Thus the calcification of the base and side walls of the body forms the cup (or calyx), while, in the centre, the columella is formed by the coalescence of the edges of the completed vertical mesenteric plates, called the primary, but sometimes independently. In like manner the "Pali," *i.e.*, posts, or props, arise from those mesenteric plates, which do *not* reach the stomach—the secondary. These varieties are called sclerodermic, and the classification thus founded is comparatively easy to understand. *They have what is called an "endo-skeleton."* But the Gorgonidae-Isidæ, and the rest of that class, which includes Red Coral, present at first sight greater difficulties. In all these, the Corallum is deposited *outside the meso-derm*, and although it forms the support (or axis) of the creature upon which the soft parts are spread, and thus appears to be *inside* it, it really *is only so because the soft tissues, or sarcode, clasps it around.* This axis is therefore *outside* the base of the actinozoon, and it is said to be Sclero-basic—to have an Exo-skeleton, like that of a crustacean. It arises thus—the ciliated embryo swims away, base forwards, affixes itself by its base to a suitable spot, and then begins to secrete corallum from it. Budding next occurs, and a branching coral is in due time the result; but no calyx is ever formed by or in the corallum, the body of the polype being retracted when required, into the soft parts which surrounds the axis, as the bark does a tree. Whatever the shape then, they may thus be distinguished from the Sclero-dermic kinds. Red Coral is, however, according to some observers, in part sclero-dermic, since it has spicules inside the meso-derm also. There seems, indeed, to *be no absolute line* of demarkation between the two classes.

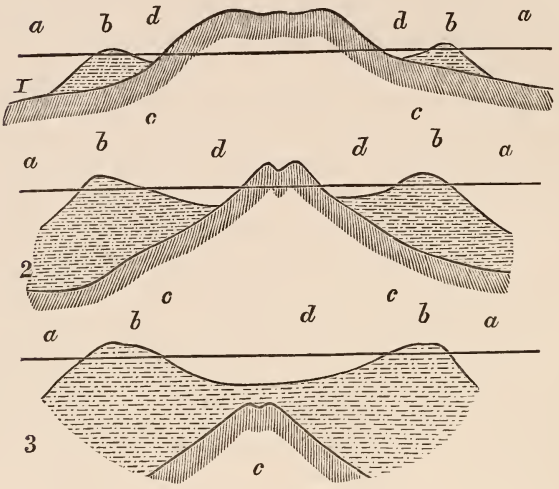
I will now try to give you a short account of the various kinds of reefs which are the result of the life of these animals. They are—

1st. Coral fringes, which lie very close to the land, and in shallow water.

2nd. Encircling reefs, lying in somewhat deeper water, and further from the shore around an island.

3rd. Barrier reefs, much further from the shore, about 60 or 70 miles off, and a hundred yards to a mile wide. That on the N.E. coast of Australia extends along the coast more than a thousand miles in length.

4th. Atolls, or lagoon islands. These are rings of coral enclosing a lagoon, or portion of the ocean in their centre; usually having an opening on the leeward side, and being apparently unconnected with any land.



Structure of Coral-Reefs.—1, Fringing-reef; 2, Barrier-reef; 3, Atoll. *a*, Sea level; *b*, Coral-reef; *c*, Primitive land; *d*, Portion of sea within the reef, forming a channel or lagoon. (From Nicholson's "Manual of Zoology.")

Corals exist, like all other living things, under limiting circumstances. These are light, heat, air, food, and probably electricity, though we know far too little of the part played by the last to be able to assign to it its due share in the general scheme. When the balance of these is disturbed, the organism affected by the disturbance endeavours within certain limits to conform to the altered conditions, or, failing that, perishes. I will now try to explain how this applies to the varying coral formations.

1st. Coral fringes are such as have existed *undisturbed* in all their vital and normal conditions, and along a coast line at moderate depths.

2nd. Encircling reefs are of the same formation and conditions, also undisturbed in their vital relations, but such as surround an island at the same moderate distance from land as the fringes.

Now, to explain the existence of barrier reefs, which lie so far from the land, and in very deep water, as well as of atolls, which have, apparently no land at all near them, we have to look for some disturbing cause which will account for their presence in depths quite fatal to the existence of the polypes, for all must die below the level necessary to secure light, heat, air, and food. This disturbance, Mr. Darwin has convinced us, we must look for in the slow subsidence of the crust of the earth. Corals can only live and flourish at depths of from 20 to 30 fathoms, and such a depth implies "no very great distance from land." Suppose, now, the bottom of the sea to sink slowly. Such corals as were at the lowest, being deprived of the necessary light, air, warmth and food, would die, and so not increase laterally, or outwards, towards the sea. But such as were near the surface would grow upwards, still trying to find subsistence by conformity to the new relations ; so that the upper edge would still remain awash with the sea, and thus flourish. Now, during this slow subsidence, the shelving coast line would evidently *seem* to be removed further from the reef by its submergence, and thus the distance of the barrier reef from land is explained. The same reasoning as easily accounts for the formation of atolls, since an island thus slowly subsiding must eventually disappear, leaving only the encirling reef to mark its position. We see, then, in each barrier-reef, a proof that the land has there subsided, and in each atoll a monument over an island now lost. The very deep and abrupt soundings outside both are thus also explained by the death and non-growth of the lowest corals. The lesser depth inside the reef is explained by the violent action of the tremendous surf in those latitudes, by the action of which masses of coral are broken off, carried over and inside the edge, and finally converted into coral sand and mud. Smaller and more delicate corals also grow inside, and help the process of diminishing the depth.

One curious fact now remains to be noticed, namely, that in most, if not all of these reefs, if a well be dug, it will be found to contain nearly fresh, or very slightly brackish water, which makes them fit for the habitation of man. These wells ebb and flow with the tides, and, according to Mr. Darwin, "are common on some of the low islands in the West Indies." The compressed sand, or porous coral rock is permeated like a sponge with the salt water ; but the rain which falls on the surface, must sink to the level of the surrounding sea, and must accumulate there, displacing an equal bulk of the salt

water. As the water in the lower part of the great sponge-like coral mass rises and falls with the tides, so will the water near the surface ; and this will keep fresh, if the mass be sufficiently compact to prevent much mechanical admixture ; "but where the land consists of great loose blocks of coral with open interstices, if a well be dug, the water, as I have seen, is brackish " (Darwin.)

With this, Mr. Chairman and Gentlemen, I now conclude, earnnestly assuring you that I have been speaking as a student to students, and that the best fate that I can wish for this paper is that it may arouse discussion, and perhaps excite criticism. In either case I shall be content, for my purpose will have been answered.

Note.—I have been requested to append a few words on the relation of the microscope to Corals. I may therefore say that on every point they are essentially microscopic, their masses, though so great, extensive, and widely spread, being composed, for the most part, of microscopic units. Of course, the polypes cannot be examined in this latitude except by the light which their British congeners throw on them. But their hard structures can be instructively examined—1st. By horizontal sections cut by the usual methods employed for *very hard* tissues. 2nd. By a plan communicated to me by Mr. Stewart, viz., splitting them vertically by the sharp blow of a hammer upon a razor ; or 3rd. By splitting them by means of a pair of cutting pliers, such as are used for wire. By either of these last methods, the most interesting and beautiful structure is revealed, which is also so delicate that it would be quite destroyed and lost by grinding, and can be properly examined by the Microscope only.

J. M.

EXPLANATION OF PLATE VIII.

Fig. 1.—Transverse section of a *Hydrozöon*, showing the body-cavity in the form of a single tube, enclosed by the body-walls.

Fig. 2.—Transverse section of an *Actinozöon* : *s*, Digestive sac ; *m*, One of the primary mesenteries dividing the body-cavity into vertical compartments. Between the six primary mesenteries are seen the secondary and tertiary mesenteries, which fall short of the walls of the stomach. *a*, Ectoderm ; *b*, Endoderm.

Fig. 3.—Diagrammatic vertical section of a Sea-Anemone : *a*, Mouth ; *s*, Stomach ; *b*, Body-cavity ; *cc*, Convoluted cords ("craspeda") containing thread-cells, and forming the free edges of the mesentery (*m*) ; *tt*, Tentacles ; *o*, Reproductive organ contained within the mesentery. The Ectoderm (*e*) is indicated by the broad external line, the Endoderm (e^1) by the thin line and the space between that and the Ectoderm.

Fig. 4.—*Actinia rosea* (after Gosse).

Fig. 5.—Calicular gemmation as seen in *Lonsdaleia floriformis*. Carboniferous.

Figs. 6 & 7.—Diagrams of the arrangement of the septa in *Zoantharia sclerodermata* and *Rugosa*. Transverse section of a simple sclerodermic coral (*Turbinolia*), showing the theca, with its projecting ridges, or "costæ," outside, the visceral chamber and radiating septa inside, and the columella in the centre. Transverse section of a simple Rugose coral (*Cyathophyllum*), showing the wall, costæ, and septa.

Fig. 8.—Portion of four corallites of *Favorites Gothlandica*, enlarged, showing the tabulæ.

Fig. 9.—Portion of a Sclerodermic coral; branch of *Dendrophyllia nigrescens*, a compound sclerodermic coral (after Dana).

Fig. 10.—Longitudinal section of *Isis hippuris*, a sclerobasic coral, exhibiting the external bark or cœnosarc, with its embedded polypes, supported by the internal axis or skeleton (after Jones).

These figures are all taken, by permission, from Nicholson's "Manual of Zoology" (5th Edition).

On the Floral Development of Helianthus annuus.

By W. H. Gilburt.

(*Read October* 25, 1878.)

PLATE IX.

In the "Journal of Botany" for February of this present year there is a paper by Dr. Maxwell T. Masters, entitled "Side-lights on the Structure of Composites," in which, after describing a proliferous and in other respects abnormal specimen of *Helenium autumnale*, he raises the question as to whether the Compositæ possess a true calyx or not. In order to find an answer more or less satisfactory, observations were made, the results of which I now propose to lay before you. Not that the examination of one species in an order containing 10,000 or more can in any sense be conclusive, but it may furnish a standard of comparison, and a point of departure.

You will all doubtless be aware that the theory now held with regard to the various organs which go to make up a flower, is "that the calyx, corolla, stamens, and pistils are, notwithstanding their varied forms and functions, only modifications of one another, and all are, again, only modified leaves."

However improbable this theory may at first sight appear, an acquaintance with the developmental history or morphology of the flower, and the fact that each and all are found reverting to the original type, will show that no other hypothesis yet advanced can be considered tenable.

The order of development of leaves in all plants is strictly acropetal, and consequently, regarding the various parts of the flower as modified leaves, they should be developed in the same order; the lowest or outermost first, the others following in regular sequence. This law holds good in most, if not in all orders but the Compositæ, and here, from some cause, it is disturbed, and the calyx does not appear till late, if at all.

In the species now under consideration, if a section be made of a very young capitulum, which is always found at the summit of either a primary or secondary stem, it will be seen that the apex of the stem has become depressed and extended in diameter, having

the form of a slightly rounded cushion, over-arched by the modified leaves or bracts of the involucre, or what was at one time regarded as the common calyx of the compound blossom.

Upon the surface of this cushion or receptacle, the florets, with their subtending bracts, are developed. The earliest appearance which they present in common with all young organs, is that of a hemispherical tubercle; those nearest the circumference of the capitulum are the first to appear, development then proceeding in centripetal order. The tubercle, however, speedily loses its hemispherical form, and appears as shown in section in Fig. 1, being a circular protuberance with a flattened summit. The free edge now begins to grow more rapidly, and a hollow upper surface is the result, the margin of which is the commencement of the future corolla (Fig. 2). On the rudimentary corolla five rounded papillæ arise—these are its laciniæ or divisions—and growth still being more vigorous on the exterior, causes an over-arching of the corolla, so producing the valvate astivation which is one of the characteristics of Composites. An early stage of this is shown in Fig. 3.

It is at this period of development that we find the first indication of the stamens as five small projections at the internal base of the corolla, and alternating in position with its divisions. This is shown in section in Fig. 3. The Anthers of all Composites are syngenesious, or so united as to form a tube, the filaments being free. This is brought about by the whole of the tissue, on which the staminal whorl originates, growing upward, so that what was at first but five papillæ is now a cylinder with five somewhat conical projections on its upper end. The tissue after a time separates near the base, at intervals corresponding with those which originally divided the stamens from each other; growth is arrested in a tangential direction, thus forming the Anthers, but proceeds vertically at the original points of emergence, till the filaments are developed.

Next in order arises the so-called calyx, as two projections at the base of the corolla, assuming at maturity the appearance of minute scale-like leaflets, or, as Sachs describes them, "sub-paleaceous Awns." If these are to be regarded as referable to the calyx, we note how late is their development—that which should have been first only just precedes, or is synchronous with the fourth whorl, for at this time we observe the first appearance of the pistil in the form of two semi-lunar prominences at the base of the stamens (Fig. 4); both the leaflets and the carpellary leaves of the pistil being arranged

radially—*i.e.*, a line drawn through the centre of each would extend from centre to circumference of capitulum. The two carpellary leaves preserve their individuality for a time, until sufficient height has been attained to form the bifid portion of the pistil, then growth commences round the whole cavity of the floret, enclosing a small hollow space at the base, thus forming the future ovary—a condition shown in two stages in Figures 5, 6, and 7, Figure 7 being a transverse section of fig. 6.

Growth now proceeds rapidly above the ovary, so that the cavity which was first at its upper part soon occupies its centre.

While this is taking place, we observe at the base of the now elongated pistil—a growth of tissue which, when fully developed, appears as a cushion or collar, encircling the style—a cellular and generally glandular body, secreting nectar, and known as the disc (Fig. 8). Whether this is its function in the species under consideration, I have not been able satisfactorily to determine.

There is one fact concerning this part of the flower which, so far as I know, has not hitherto been observed—at least, it is not referred to in any papers, nor shown in any figures that I have seen—*i.e.*, the presence in comparatively large numbers of perfectly developed stomata. Whether they are accompanied by the usual intercellular spaces I am not able at present to say, the cell-walls of the disc being so extremely thin that it is difficult to decide whether two cells are in contact or not. The stomata however are so numerous, that on a disc—when only $\frac{1}{80}$ of an inch in diameter—I have counted as many as 54.

We come now to the development of the ovule, concerning which in some particulars authorities are not agreed.

In the Compositæ we always find an unilocular ovary, and the ovule erect and anatropous, one question in dispute being whether the ovule is a development of the floral axis and also its termination, or a lateral development upon it; some authorities, amongst them Sachs, holding the latter view. Kohne appears to regard it as a development from one of the carpels, but from which he was not able to say. It is difficult, however, to see how either can be supported in the species we are dealing with, as the first indication we have of the ovule is an uprising of the floor of the ovary, the centre of which is slightly conical, as shown in Fig. 10. True, in the earliest stages the base of the funiculus is somewhat inclined to the carpel which is nearest the centre of the capitulum; but this fact seems to favour the hypothesis of the axial character of

the ovule, as, were it lateral upon the axis, and having regard to its direction of growth, which is always towards the centre, we should hardly expect to find it so inclined, but rather that its point of origin was nearer to the outer carpellary leaf, leaving a space for the rudimentary or suppressed axis. The terminal character of the ovule receives further support from the consideration of its after development, which points to the nucleus being the termination of the floral axis, the other point concerning which doubt exists ; those who regard the ovule as lateral, and consequently as a modified leaf, considering it a new formation on its superior surface.

Growth of the funiculus from the first proceeds unequally, most rapidly on that side which is towards the circumference of the capitulum, the result being that its base speedily becomes horizontal, and that that point which was originally axial in position, and which seems to me to be the true floral axis, is by degrees forced over, and is found as a slight projection on the inner side below the summit. Figures 11 to 13 represent this at various periods of its progress.

When the funiculus has attained the height of $\frac{1}{250}$ of an inch, the first indication of the integument is seen as a ridge across its summit (Fig. 14), which, growing forward, forms a hood-like projection over the now apparent nucleus, for the original apex has begun to grow faster than hitherto, and to keep pace with but slightly in advance of the integument. It has also altered in appearance and character, being clear and transparent, the cells being most distinctly nucleated. The young nucleus at first stands at right angles to the funiculus, but during development it is gradually depressed through an angle of 90°, and thus attaining its anatropal character (Figs. 15, 16). At length its further development is retarded, and it becomes covered by the integument, or primine, the ovule having but one envelope.

Now having regard to the facts as above stated—first, that the earliest indication of the ovule is a rising of the floor of the ovary, with a bluntly projecting centre ; second, that growth proceeds more rapidly on the exterior side of the funiculus, by which the blunt point of the centre is gradually forced over, though never lost, that the nucleus is developed at this point at the same time, or just after the primine—it seems to me we cannot regard the ovule as other than a terminal structure, and the nucleus as the apex of the floral axis.

Turning now to the question as to the presence or absence of a

calyx in the Compositæ, Dr. Masters refers in his paper to the various opinions held by botanists of authority upon the subject, and says, "For my own part, I am disposed from the facts above-mentioned, and from my examination of a large number of teratological specimens, to agree with those who, like Buchenau and Warming, are of opinion that at present Composites have no true calyx, or only traces of it, and that the pappus consists of mere appendages or outgrowths not referable to distinct sepals. Buchenau suggests that pre-historic Composites had a five-leaved calyx, which has become effaced as time has rolled on, from the pressure exerted by the densely packed flowers." Then, after citing the opinions of Lund and Hofmeister, that each pappus hair, or scale, represents a sepal; and pointing out that Warming, in opposition to this theory, shows that they do not correspond in position, nor agree as to period of development with sepals, and that the slight rim which forms beneath the corolla should be regarded as the true calyx, Dr. Masters says, "In all these points I am disposed to concur with the Danish naturalist (Warming), who further refers these organs to *Trichomes* rather than to *Phyllomes*, on anatomical grounds, upon the validity of which I am in no position to offer an opinion."

In *Helianthus* we have two series of structures which have been referred to calyces by different authorities, viz., *Trichomes*, or hairs, which are found at the base of the corolla, and the two scale-like leaflets which surmount the ovary.

Duchartre appears to have been the first to observe and refer the former to the calyx, and he describes their development, first as a ring of tissue, which afterwards, for the want of parenchyma, splits up into plates and eventually into hairs composed of a single series of cells. In this developmental history I cannot help thinking he was mistaken, as after a very careful examination of a large number of florets in all stages of development I have not been able to see them in any other form than that which he describes as the final one. Moreover, they do not occupy one plane, but extend over a considerable space; they each have their origin in a single epidermal cell, and are but the termination, though more fully developed, of a series which extends upward from the base of the ovary. Again, if we regard them as representing the calyx, the difficulty as to retarded development is greatly increased (this Duchartre himself points out), as they are not seen till the ovule is well advanced. From these considerations it would appear that they are only referable to Trichomes.

With regard, however, to the two leaflets or scales there are certain facts which, as it seems to me, will prevent their reference to the same class of appendages, whether we regard them as sepals or not.

"Trichomes," according to Sachs, "is the term given in the higher plants to those outgrowths which arise only from the epidermis, *i.e.*, from the layer of cells which always remain the outermost in roots, stems, and leaves." According to Warming, they are of two kinds, viz., hairs, as we generally understand the term, and "emergences," the last being the strongest, and sometimes containing a rudimentary vascular bundle. To this last class the tentacles of *Drosera* would belong.

Now with the definition just quoted, the structures under consideration certainly do not agree, their origin being the same as that of all leaves—an extension of the Dermatogem and an outgrowth of the underlying periblem in the form of a tubercle. That they have a broad base of insertion is shown in Fig. 6, the dotted line representing their form and position at this stage of development. It will be observed that their point of origin, as shown in Fig. 4, is on a level with that of the carpellary leaves, and for some time this position is preserved, but ultimately, owing to more vigorous growth on the periphery, they are found surmounting the ovary (Fig. 9).

At maturity they are leaf-like in form, with a serrated margin (Fig. 17). In section, at their thickest part I find six or seven layers of cells beside the epidermis. Up the centre from base to apex runs a fibro-vascular bundle containing four or five spiral vessels; on either side there is another bundle, with a spiral vessel or two for about one-third their lengths; these anastomose with the central one before reaching the apex. Outside these there are three bundles, still more rudimentary in character, and extending but a short distance into the lamina, in one of which there are no vessels. Both stomata and chlorophyll are absent.

Simple as is the structure of these leaflets, and far removed as they appear from either leaves or sepals of the ordinary type, I think it can be easily shown that we have a series of links, almost complete, which will connect the two extremes with each other.

In Figs. 18 to 22 are shown a series of bracts from one capitulum, Fig. 18 being at the same time the innermost bract of the involucre and the outermost floral one. Now between this and the ordinary foliage leaf examples may at once be found which will convince the most superficial observer that the one is but a modified

form of the other, although in size, outline, and structure such a great divergence has taken place ; and continuing the series, we find bracts in which further modification has taken place, and which will, so far as structure is concerned, demonstrate that these diminutive scales, whether regarded as sepals or not, are certainly not Trichomes.

Taking now the bract (Fig. 18), we find it abundantly supplied with chlorophyll, but which gradually diminishes in quantity as the bracts get farther away from the circumference of the capitulum ; this is shown in the figures, the shaded portions representing the decreasing surface occupied by it. Another feature to be observed is that they become greatly reduced in substance, and at last scale-like in appearance, the only part containing chlorophyll being that which, projecting above the floret, is exposed to the influence of light. Only one vascular bundle is present, that representing the mid-rib ; stomata are also absent, except upon the green portions ; the chlorophyll, the vascular system, and the stomata disappearing together, and were it not that some portion of the bracts were still exposed to the influence of light, we should find them in all respects as rudimentary as the two leaflets under consideration ; as it is we find they nearly approach each other.

Taking then the facts above cited as to origin and structure, together with the circumstance that the subtending bracts of the florets do not differ much in the latter particular, I think we must conclude that they belong to *Phyllomes* rather than *Trichomes*, and if so, we can scarcely help referring them to the calyx, in spite of their retarded development and want of symmetry ; for if we regard them as bracts joined to the ovary, as Duchartre suggests, the same difficulty as to retardation presents itself, but in a greater degree.

EXPLANATION OF PLATE IX.

b. bract.	*co.* corolla.	*s.* stamens.	*cp.* carpels.	*d.* disc.
p. pistil.	*sp.* sepals.	*a.* apex.	*f.* funiculus.	*pr.* primine.
n. nucleus.	*ov.* ovary.	*sk.* ovule.	*v.* vessel.	

Figs. 1— 9. Development of Florets ; 6, Transverse section of fig. 7 ; dotted line, Fig. 7, position and form of sepals.

„ 10—16. Development of ovule ; 14—16, development of primine and nucleus.

„ 17. Sepal, showing position of rudimentary fibro-vascular bundles.

„ 18—22. Floral Bracts from one capitulum ; shaded portion indicates extent of surface occupied by chlorophyll.

On the Queen Bee,

With Especial Reference to the Fertilization of her Eggs.

By John Hunter.

(*Read Oct. 25th*, 1878.)

The life history, functions, and attributes of the Hive Bee, have for more than 2,000 years engaged the attention of Naturalists and other men of science. Apiarian students have numbered in their ranks men whose pre-eminent learning have left their names as landmarks to posterity, and who will never be forgotten while history exists. Among the ancient philosophers who have studied and written upon the Bee, I may mention Virgil, who devoted the whole of his Fourth Georgic to the subject; Cicero, Pliny, Aristomachus, Philiscus, Columella and Celsus; and within the present century we have the great naturalist, Swammerdam, the mathematician Maraldi, Réaumur, the inventor of the thermometer which bears his name, my illustrious namesake, John Hunter, the anatomist, and Huber, of Genoa, whose total blindness did not prevent his giving to the world many facts in the bee's life history which were before unexpected. Without approaching nearer to our own time, the above array of brilliant names as examples will sufficiently excuse any amount of attention we lesser lights may give to an insect so small, but yet of great and increasing service to mankind.

When so many learned men have been before us, it may be assumed that the subject is well worn, but the fact is, that, from the imperfect means of observation enjoyed until lately, mainly by the misconstruction of hives, facts have been so mixed up with surmises and wrong deductions drawn, that it became a difficult task to separate the true from the false. A colony of bees consists of workers which may number 50,000 or more, in summer a few hundred drones, and *one* queen, who is the only individual in all this vast assembly capable of propagating the species. At the present time, the month of October, we may safely assume that under normal circumstances the queen in any hive is the mother of every other bee there. The

drones are males, and what I have just said, will, of course, have informed you that the queen is the female ; and the question naturally arises,what are the workers ? They used to be styled neuters, but they are not so, they also, as well as the queen, are females, differing in the fact that their sexual organs are not fully developed. Drones, workers, and queens, of course, are all bred primarily from eggs, and those gentlemen who have made no special acquaintance with bee history, will perhaps feel surprised when I say that the eggs which produced the queen and the workers were, when deposited by the mother bee, identically of the same kind, and either could at the will of the bees, who may even be influenced by the will of the bee master, by skilfully directing them, as his agents, be made to give birth to either queens or workers—nay, I will even go further, and say, that I believe it possible that the skilful experimentalist could so direct that some selected eggs, which, left to themselves, would give eventual birth to drones, should be made to produce drones, workers, or queens at will. To elucidate this problem, I must beg your attention while I trace the history of a bee, not only from the deposition of the egg, but from the growth of the latter in the ovary of the mother, and it will also involve an explanation of the theory of Parthenogenesis.

On dissection of a queen, we find within her abdomen a pair of ovaries, as on the diagram to which I direct your attention, as also to the preparation of these organs under the microscope. We see each ovary consists of a great number of tubes, containing eggs in various stages of development, and all these tubes lead to a right or left duct which again unites into one main channel down which the eggs pass ; at the side of this latter duct we find a little globular sac opening into the oviduct ; this sac is called the spermatheca, and is filled, when the queen has had copulation with the male, with the usual whitish seminal fluid, containing countless thousands of spermatozoa in full activity. I have here an impregnated queen, from which I will show you it is easy to dissect out the spermatheca, and verify its contents to be as I state. Seeing these active bodies all wriggling and twisting like so many eels, it is hard to believe they are not animalcules, as was long thought. To return to the eggs : when arrived at maturity they glide down the oviduct from either ovary, and on passing the opening of the spermatheca, receive one or more spermatozoa, which, penetrating the egg's substance, causes the birth of a worker larva ; but it may so happen that the egg in

its passage, does not, either from volition, or inability of the queen, receive impregnation, in this case it does not perish or addle, but gives birth to a *drone* larva, and it has been conclusively proved that the act of fertilization or not determines the sex of the future bee. The egg being fertilized and deposited, it hatches in about three days, and the young larva receives the careful attention of the worker bees, who feed it with appropriate food, and in due time it passes to the pupa state, on the 21st day becoming a worker bee, but the same egg that produced the worker in 21 days could, had the bees been so minded, have been bred up to a queen in 16 days. The bees only rear queens when necessity calls for them, either from loss of their old monarch or apprehended swarming. If I remove the queen from a hive, the first of these contingencies occurs, and after a period of a few hours' commotion, the bees select certain of the worker eggs, or even young larva, two or three days old, the cell is enlarged to five or six times its capacity, a superabundance of totally different food supplied, and the result is that, in five less days than would have been required for a worker, a queen is hatched. The marvel is inexplicable, how a mere change and greater abundance of food and a more roomy lodging, should so transform the internal and external organs of any living creature. The case is without a parallel in all the animal creation—it is not a mere superficial change that has been effected, but one that penetrates far below form and structure, to the very fountain of life itself. It is a transformation alike of function, of structure, and of instinct. On the birth of the queen, her wings are limp, and hairs clotted with moisture, but she is in full activity, the workers assist in her release from the wax-cell in which her transformation takes place, but they pay very little or no attention to her so long as she remains a virgin.

The impregnation of the queen bee was long an enigma to Naturalists ; some have denied that any intercourse with the male was necessary for the fecundation of the eggs. Some supposed that the effluvia arising from the males within the hive was sufficient for this purpose. Maraldi thought the eggs were fecundated by the drones after they were deposited, in the same way that the spawn of fishes is fecundated ; but, from our extended means of observation, we are no longer in any doubt as to the *modus operandi*. From three to seven days after birth, the queen issues from the hive, on nuptial thoughts intent, and after circling a few times round her home, apparently taking its bearings, she flies away into space ; if

her trip be fortunate, and she meets a drone, they fall together to the ground, where separation quickly takes place, at once fatal to the drone, who parts with his sexual organs, which remain attached to the queen on her arrival home ; these quickly shrivel up, and are removed by the workers. In the act of coition the spermatheca of the queen is injected with the seminal fluid, and, wonderful to relate, this small vessel whose external measurement is but $\frac{1}{32}$ of an inch, contains sufficient material to fertilize all the eggs which the queen may lay in her whole life (for she mates but once), although she may live four or five years, and deposit during this time more than a million eggs. Dzierzon, a highly scientific German bee-master, says, " Most queens in spacious hives at a favourable season, lay 60,000 eggs in a month, and a specially fertile queen in four years, which she on an average lives, lays over 1,000,000 eggs." On this authority I make this statement, and I do not think it is an exaggeration. Referring back to my text that " the act of fertilization [of the eggs] or not—determines the sex of the future bee," you may naturally ask how I prove this statement, or that the unfertilized eggs will hatch at all. Professor von Siebold made many most skilful microscopical dissections of eggs, and he affirms that among 52 eggs taken from worker cells examined by him, with the greatest care and conscientiousness, 34 furnished a positive result, namely, the existence of seminal filaments, in which movements could even be detected in three eggs, and among 27 eggs from drone cells examined with the same care and by the same method, he did not find one single seminal filament in any egg, either internally or externally. A phenomenon sometimes occurs in a beehive of a queen laying eggs that produce males only ; this for ages had puzzled philosophers, without any satisfactory solution, but if you will bear in mind what I have said, and admit it as fact, the solution is easy. The theory of Parthenogenises (or virgin breeding) which Dzierzon promulgated in 1845, is said to have explained this phenomenon of the beehive as perfectly as the Copernican hypothesis the phenomena of the heavens. The principal points to bear in mind are—that the queen to be able to breed workers must be fertilized by the drone, and that the union takes place only in the air—that drone eggs do not require fecundation, but that the co-operation of the drone is absolutely necessary when worker bees are to be produced—that in mating the ovaries are not fecundated, but the seminal receptacle (the spermatheca) and that the supply of semen thus re-

ceived is sufficient for her whole life-time. We prove these hypotheses as follows :—Eggs laid in drone cells never produce aught but drones—a queen born with her wings imperfect rendering her unable to fly, or one born after drones are all dead (generally by August), and consequently unable to mate, lays eggs indiscriminately in both drone and worker cells, but all alike produce drones. The verification of this is very easy, we have but to deprive a stock of its queen in autumn, and provided there are eggs in the hive, young queens are sure to be reared, and as surely they will become drone breeders; the experiment has been so many times repeated that the fact is now incontestible. That a queen mates but once in her life, the introduction of the Ligurian bee into England enables us to prove. This variety has the reputation of being a better one than our own native bee—and it is a common practice to import annually from Italy fertile queens, which, by a little skilful management, are made to take the places of the rightful sovereigns in our English hives. The Ligurian bee is gaily striped with yellow bands, and we quickly find the original black bees are dying out, and replaced by the easily distinguished Italians, and while this naturalized queen lives, the bees of her hive are thorough-bred Italians. I will presently dissect out, and display the contents of the spermatheca of a fertile queen, which will exhibit many thousands of the spermatozoa, with their characteristic contorted movements. I will then perform the same operation on a virgin queen, when we shall find the contents of the spermatheca a limpid fluid only, not a trace of the spermatic filaments. My namesake, the great surgeon, attempted to fertilize drone eggs by artificial impregnation from the spermatheca of a queen—he failed with the bee, but succeeded with the silkworm moth. Dr. Dönoff is stated to have been more successful, and I see no reason why the experiment should at all times fail. Cases sometimes occur, when a hive is queenless, that one or more workers will develop the power of ovipositing ; it is reasonable to suppose from their diminutive size and general non-perfection of their organs, that the functions of the drone had not been performed ; certain it is that eggs of a fertile worker produce drones only, and in one solitary case, where such a worker came into my hands for dissection, although I found ovaries and eggs, I could discover no spermatheca. It has been a common subject for authors to dilate upon the respect and reverence bees pay to their queen, and the valour with which they defend her. This, although very pretty, I am sorry

to say, is all fable. The bees' attention to the queen is solely in interested motives, that is care for the eggs. A virgin queen receives no attention whatever, no defence is ever offered for the queen. I never hesitate to pick up a queen from the midst of her subjects, to which the bees pay no heed, and in cases where an eruption of strange workers takes place in the hive, the rightful inhabitants will suffer their queen to be seized and ill-treated by the intruders without resentment. A queen is possessed of a sting, but I have never known her use it as a weapon, except in combat with another queen—but it is probably used to direct her ovipositor when in use.

PROCEEDINGS.

The following paragraph was accidentally omitted from the Report of the Proceedings of the July meeting. Its place is in page 101, between lines 30 and 31.

"Attention was called by the Secretary to the fact that since the last meeting two of the gentlemen proposed for election as Members of Committee—Mr. Guimaraens and Mr. Simpson—had withdrawn their names; the four remaining names would therefore stand to fill the four vacancies in the Committee, and the members would not be at liberty to strike out those names, or to substitute other names for those nominations, but they could do so in the case of the nominations for the offices of President, Vice-Presidents, Treasurer and Secretaries."

August 9th, 1878.—Conversational Meeting.

The following objects were exhibited:—

Exudation from surface of Terra-cotta	Mr. F. W. Andrew.
Brilliant eyes of *Crysops relictus* (Cattle fly) ...	Mr. F. Enock.
Scale of Sole	Mr. W. Goodwin.
Thumb of Human foetus, injected	Mr. J. J. Hunter.
Flint stained with acetate of roseaniline ...	Mr. M. Hawkins Johnson.
Fossil Corals from Corwen	Dr. J. Matthews.
Micrasterias denticulata, mounted more than 12 months ago	Mr. A. D. Michael.
Stems, &c., of *Chara*, in flint	Mr. G. J. Smith.
Section thorn of Gooseberry	Mr. F. H. Ward.
„ „ Bramble...	
„ Stem of *Alisma plantago* ...	
„ Flower of *Butomus umbellatus* ...	

Attendance—Members, 35; Visitors, 3.

August 23rd, 1878.—Ordinary Meeting.

Dr. J. Matthews, F.R.M.S., Vice-President, *in the Chair.*

The minutes of the preceding meeting were read and confirmed.

The following gentlemen were balloted for and duly elected members of the Club:—Mr. John H. Steel, Mr. Washington Teasdale, Mr. George F. Watson. Four gentlemen were proposed for membership.

The following Donations to the Club were announced:—

"Science Gossip"	from the Publisher.
"The Medical Examiner" (weekly)	„ „ Editor.
"Proceedings of the Royal Society"...	„ „ Society.

"Proceedings of the Belgian Microscopical Society" from the Society.
The last volume of the Ray Society's publication ... by subscription.
"Annals of Natural History"... ... ... „ purchase.
"Journal of the Cincinnati Natural History Society" from the Society.
"Annual Report of the Brighton and Sussex Natural History Society" ... ... „ „ „
"Quarterly Journal of Microscopical Science" ... by purchase.
"The American Naturalist" ... ... in exchange.
"The American Journal of Microscopy" ... ... „ „
10 Slides of Acari ... ... from Mr. Michael.
A Photograph for the Club Album ... ... „ Mr. H. Davis.

The thanks of the Club were unanimously voted to the donors.

The Chairman said it appeared that they were without any formal paper to be read that evening, but he had observed that when such was the case it often happened that the meetings were not the less interesting. He would suggest that the results of their vacation rambles would form very interesting topics for conversation. It was not matters of great importance which they desired, for, as microscopists, they did not despise the day of small things. Perhaps whilst others were preparing to say something, Dr. Cooke would be kind enough to offer some remarks upon some subject, which from him would be sure to be interesting.

Dr. M. C. Cooke, having expressed his willingness to gossip for a few minutes, said that when one had ever so many ideas stored up in one's head, it was sometimes rather difficult to pick and choose amongst them at a moment's notice; he had, however, had so much to do with one group of organisms, that it would be strange if he could not find something to talk about in connection with them. It was that old *mouldy* subject which always cropped up whenever he got upon his feet. One of the commonest things in the whole group was the common blue mould, and whilst he proceeded to describe it, he would just for a moment assume that the members of the Club before him were a class of persons who had never before heard of such a thing as blue mould. They had doubtless heard something of a vinegar plant, a film of ropy substance which was often cultivated domestically for the purpose of producing vinegar by letting it grow in any sweet mixture, such as sugar and water. In most cottages in the country they would find it to be well-known, and most cottagers were very proud of it; he had tried the vinegar of some of the most experienced producers, and could only say that he should be very sorry to call it vinegar himself. If this vinegar plant was exposed to the air, and its means of subsistence was allowed to get dry, it would no longer increase in its former manner, but it turned about to seek some other means of development. There were two phases of fungi—the reproductive and the vegetative. The common mushroom exhibited both of these; the stalk, the cap and other portions representing the vegetative growth, whilst under the cap were found a number of gills on which myriads of spores were developed, and these were the reproductive portions, and sometimes it happened that under special circumstances, in the mushroom the reproductive growth became checked.

The vinegar plant was naturally vegetative only ; year after year cells were added to cells, and filaments to filaments, but there was nothing to be found about it of the character of a seed. So long as sweet water was supplied to it, so long it kept growing in this manner; but if a check took place and it could no longer get what it wanted to feed upon, directly it began to starve, it shot up a number of filaments, and it became covered with a beautiful crop of blue mould. When these filaments were developed to their full extent, a number of chains of bead-like spores appeared at the top, hence this mould was called *Penicillium*. No end of these were produced, and when the spores ripened and dropped off, every one was capable of producing a plant. Each chain, it would be observed, proceeded from a small branch, each of them growing in pairs, the top of the thread forked out into some elongated cells, and on these grew the chain of spores. If any member of the Club, who was desirous of studying these things, did not happen to possess a vinegar plant or a piece of mouldy bread, if he were to take up a small portion of fresh horse-dung and put it under a bell glass, in 48 hours he would have a strong supply of this mould. If they shook off some of these spores into a hollow glass slide containing a little sugar and water, they would in the course of a few hours be able to detect each one sending out a short filament, and branching out in various directions. Each spore would measure, say the $\frac{1}{200}$ of a millimetre or ·005 of an inch, and each one was perfectly capable of producing a vinegar plant. Another mould, nearly of the same size, and resembling it to the naked eye, was found in similar places. The top of the stem is swollen and simple, the chains of spores are seated on elongated cells, which spring from the thickened apices of the threads. This is the *Aspergillus glaucus*. Another remarkable thing might be observed in this mould—when it grows on some substances, under favourable conditions, the mycelium at the base curled up at the ends in a curious way, twisting itself round like a corkscrew, until at length it became quite like a ball. It then became absorbed into a globose form, clear and colourless, and containing a number of globules. Gradually the outside wall thickened, it became of a yellow colour, and it was transformed into a fungus of a different character, belonging to a different group, and as widely distinct from its original type as a blade of grass was from a walnut tree. The structure of these globose bodies was an outside reticulated wall containing cells called *asci*, these again containing eight small bodies called sporidia; when the outside case broke, the *ascus* opened by a small lid, and the spores escaped, and each one of these was capable of producing not always something like itself, but either of the other species. This fungus was known as *Eurotium herbariorum*, and upon old specimens of dried flowers or insects they would often find these little golden balls, which were only another phase of the growth of a very common mould.

The Chairman said that it had passed into a proverb that it was difficult to speak gracefully upon common things, but this task their friend, Dr. Cooke, had successfully accomplished. He should be glad to hear

observations from any gentleman present upon the subject, though he thought they must admit that it was very difficult to come after Dr. Cooke, seeing that what he said was usually almost exhaustive. Meeting with no response, he then called upon Mr. Ingpen to give them some observations upon a question of great optical importance; he need not tell them that much depended on how they saw things, the importance of the question often depending far more on *how* than *what* they saw.

Mr. Ingpen then gave an account of the present state of the "angular aperture" question, and exhibited and described Professor Abbe's Apertometer.

The Chairman invited observations upon the very interesting subject which had been placed before them, and thought that Mr. Ingpen had thrown a flood of light upon a matter which was a very difficult one. The presence of oil between the front lens and the object stood much in the same relation as the field lens of the eye-piece to the eye-lens; it collected rays which would otherwise be lost. If the field glass of an eye.piece was taken out, they would still see the object, but only a small portion of it, though more magnified, but when placed in its position again they would find that the field lens gathered in many rays of light which would otherwise be lost. He might compare this effect to that of a number of wires surrounding a hyacinth in its glass; they spread out very much until a ring was put round them to gather them together.

Mr. Ingpen further illustrated this effect by a drawing on the black board.

The thanks of the meeting were unanimously voted to Dr. Cooke and Mr. Ingpen for their communications.

Announcements of meetings for the ensuing month were then made, and the proceedings terminated with a conversazione, at which the following objects were exhibited:—

Stained tissue of *Cystsopteris bulbiferum*	Mr. T. H. Buffham.
Lining of nest of English Trap-door Spider—*Atypus Sulzeri*	Mr. F. Enock.
Section of leaf of *Pinus sylvestris*	Mr. W. H. Gilburt.
Pollen of Japanese Lily	Mr. W. Goodwin.
Various Anatomical Injections	Mr. J. J. Hunter.

Attendance—Members, 44; Visitors, 5.

September 13th, 1878.—Conversational Meeting.

The following objects were exhibited:—

Cuticle of Water-cress, showing crystals and raphides	Mr. F. W. Andrew.
Elytron of Oak Weevil	Mr. G. Beaman.
Dentate Antennæ of Goat Moth	Mr. F. Enock.
Frond of Stag-horn Fern, transverse section, double stained	Mr. W. H. Gilburt.
Hairs of *Deutzia scabra*...	Mr. W. Goodwin.
Section of Jaw of Cat, showing four teeth	Mr. J. J. Hunter.

Cuticle of leaf of *Fuchsia* showing bundles of raphides Mr. C. Le Pelley.
Polyxenus lagurus ... ... Mr. A. D. Michael.
Micro-rulings on glass 1,000 to 20,000 to the inch
Compound vibration and Geometric curves ... } Mr. Washington Teasdale.
Star ruled on glass by the late Mr. Stannistreet
Larva of *Coccinella bipuncta* ... ... Mr. T. C. White.

Attendance—Members, 38; Visitors, 5.

September 27th, 1878.—Ordinary Meeting.

Charles Stewart, Esq., M.R.C.S., &c., Vice-President, *in the Chair.*

The minutes of the preceding meeting were read and confirmed.

The following gentlemen were balloted for and duly elected members of the club:—

Mr. H. T. Ashby, Mr. Heneage Gibbes, Mr. George D. Plomer, and Mr. Robert G. West.

The following Donations to the Club were announced:—

Proceedings of the Royal Microscopical Society ... from the Society.
,, ,, Watford Natural History Society ,, ,, ,,
Eighth Report of the Croydon Microscopical Club ... ,, ,, ,,
Annual Report of the West London Scientific Association ... ... } ,, ,, ,,
Proceedings of the Belgian Microscopical Society ... ,, ,, ,,
"Science Gossip" ... ... ,, ,, Publishers.
"The Analyst" ... ... ,, ,, ,,
"The American Naturalist" ... ... in exchange.
"The American Journal of Microscopy" ... ... ,, ,,
"The Annals of Natural History" ... ... Purchased.
58 Slides of Acari
16 ,, Shells of Mollusca } ... ... from Mr. J. F. Cocken.

Photograph of Mr. A. H. Halley, and a photograph of the grave of the late Professor Quekett, the latter presented by Mr. T. H. Powell.

The thanks of the Club were unanimously voted to the Donors, and, on the motion of the Chairman, a special vote of thanks was accorded to Mr. J. F. Cocken, of Botsdale, for his valuable additions to the Cabinet.

The Secretary read a letter from Dr. Alfred Carpenter, President of the Croydon Microscopical Club, inviting the co-operation of Members on the occasion of the *Soirée* of that Society, which was fixed for November the 6th.

Dr. J. Matthews read a paper "On the history and structure of Corals," the subject being illustrated by numerous diagrams and by models and specimens exhibited in the room.

The Chairman said that they had, by the applause which followed the conclusion of the paper, anticipated the proposal that he was about to

make, namely, that their very best thanks be presented to Dr. Matthews for the very excellent paper which he had given them. The whole subject was one of extreme interest to Microscopists, and it was well known that the corals furnished them with some of the most lovely objects which they possessed, so that hardly a cabinet could be found which did not contain specimens of spicules and other portions from this interesting group. He would just point out one little matter in connection with the subject—it was formerly always taught that the septa of the stony corals were due to the calcification of the mesenteries; this, however, was not the case, for it was found that the septa arose from an independent growth in the intervals between the mesenteries. The septum in the actinozoön corals was *beneath* the tentacles, whereas the mesentery was *between* them. He asked the members to return their hearty thanks to Dr. Matthews.

A vote of thanks to Dr. Matthews was carried by acclamation.

Mr. Hardy enquired whether any cause had been found for the red colour of the coral? Also, if the cause of the stinging property of the anemones and hydras was explained; was it electrical or something of a poisonous nature?

Dr. Matthews believed the stinging property to be the result of a purely animal poison, of the nature of which they knew nothing. As to the cause of the colour, he confessed himself to be utterly ignorant on the subject.

Mr. Stewart regarded the colour as being in all cases organic in its nature; in some cases it was clearly due to the colour of the fleshy part covering it. As regarded the stinging power, he had often watched the behaviour of prawns which came in contact with the anemones, when the anemone was taking its breakfast, for instance, and the prawn had tried to take it away. No inconvenience seemed to be suffered by the prawns, who, probably, were able to resist the stinging property, but a fish coming into contact with it exhibited great distress in consequence.

Dr. Matthews said that Mrs. Somerville regarded the white varieties as diseased specimens, and he believed that the dealers also said it was diseased coral; but they seemed to know very little about why they said so.

Mr. Frank Crisp said he for one would be very glad if Dr. Matthews would carry out his idea of a series of papers, like the one he had read that evening as he could hardly imagine anything more useful to them than such papers, which conveyed a great deal of instructive and useful information, though perhaps they might contain little which was absolutely new; and he should decidedly like to see a series of papers upon "What is Rotifer?" "What is a Sponge?" and so forth, in preference to endeavouring to obtain nothing but original papers. Another subject to which Dr. Matthews referred was that of their excursions. It had often been a matter of surprise to him that the excursions produced so little result in that room, and he thought that if those who went to them would preserve what they gathered and bring it to the Club on the gossip evenings, many of those members who could not go to the excursions would be only too glad to have some of the specimens.

Mr. Curties said he should like to ask a question on one point, and that was, whether Dr. Matthews could give them any information as to the form of preparation which should be adopted to make this class of objects into those pretty and instructive slides which they had so often admired?

Mr. M. H. Johnson thought Dr. Matthews had expressed the opinion that these creatures had the power of separating carbonate of lime from the water of the ocean. He was not aware that the ocean, at any distance from the land, contained carbonate of lime; but he thought it probable that it was separated rather as a sulphate of lime, and that the sulphur served some kind of purpose in the animal economy.

Dr. Matthews regarded this as an extremely difficult question in animal chemistry, and one which it was not easy to answer without careful consideration. He called the attention of the members to a number of specimens upon the table, lent in illustration of the subject by Mr. Newton and Mr. Stewart, and expressed his thanks to those gentlemen for the valuable assistance thus rendered.

Mr. Ingpen wished to say just a few words with respect to two or three remarks which they had heard that evening. He felt sure that all must be thoroughly aware of the extreme value of such papers as that which they had just listened to; it was one of a class which could not fail to be most useful, and of which they had already had a specimen in the valuable series of papers by Dr. Braithwaite, on the "Histology of Plants." He hoped, however, that they would not be too ready to adopt the advice of giving up the idea of original research, and letting all such papers drift to the Royal and other Societies. Any one who looked through their Proceedings would find a number of original communications, some of which were of considerable value and interest, and he should be very sorry indeed if it were to become an established custom that any of their members who did any original work, or found out anything new, should feel bound to run off with it to some other Society instead of endeavouring to add to the reputation of their own. Whilst, therefore, he valued very highly such papers as that of the evening, he still hoped that those members who were thinking out matters for themselves, or who were making original observations, would none the less give the Club the benefit of them. With regard to the excursions, he wished they could have a little more information as to their results reported before the meetings; but it should be borne in mind that objects which had been collected at the excursions *were* frequently brought to the meetings. It was not very easy to do this at all times; if, for instance, there were to be an excursion to-morrow, he should like to ask what would be the condition of many of the objects by the time of the next gossip night? It might be remembered that he stated at one of the meetings the result of an excursion to Hampton Court, and gave a detailed list of the rare and valuable objects then obtained. He was quite sure that those members who brought home specimens were willing to share them with others.

Announcements of meetings, &c., for the ensuing month were made,

and the proceedings terminated with a conversazione, at which the following objects were exhibited :—

Madreporiform tubercle of *Uraster rubens*... ...	Mr. T. H. Buffham.
Head and Tongue of Queen Wasp, *Vespa rufa* (prepared without pressure)	Mr. F. Enock.
Pupa of Indian plant bug	Mr. H. E. Freeman
Leaf of *Hydrocharis*	Mr. W. H. Gilburt.
Section of foot of Human Foetus...	Mr. J. J. Hunter.
Specimens of Corals in illustration of paper ...	Dr. J. Matthews.
Fossil teeth from Bristol Bone bed—Lyme Regis	Mr. T. H. Powell.
Peridermium columnare	Mr. H. J. Roper.
Fossil and recent Corals	Mr. C. Stewart.

Attendance—Members, 65 ; Visitors, 4.

October 25th, 1878.—Ordinary Meeting.

Professor Huxley, F.R.S., President, *in the Chair.*

The minutes of the preceding meeting were read and confirmed.

The following gentlemen were balloted for, and duly elected members of the Club:—The Rev. H. M. Clifford, M.A., Captain F. E. Dowler, and Mr. Wm. E. Howling.

The following donations to the Club were announced :—

"Proceedings of the Royal Society"	from the Society.
"Proceedings of the Bristol Natural History Society"	" " "
"Grevillea"	Purchased.
"American Journal of Microscopy"	in Exchange.
"Quarterly Journal of Microscopical Science" ...	Purchased.
"The Popular Science Review"	from the Publisher.
"Science Gossip"	" " "
"The American Quarterly Journal of Microscopy"	" " "
3 Slides	" Mr. A. D. Michael.

Photograph of Mr. C. Le Pelly.

The thanks of the meeting were unanimously voted to the donors.

The President said that it gave him great pleasure on this, the first occasion upon which he had the honour to preside at one of their meetings, to be able to lay before the Society a work which would contribute very much to the usefulness of the collections in their possession. It was a new and revised catalogue of the microscopical preparations in the Cabinet of the Society, and great praise was due to their Curator, Mr. Hailes, for the very efficient manner in which he had carried out this work; the committee had expressed their sense of the value of this service by passing a vote of thanks to Mr. Hailes, and he would now ask the meeting to do the same.

A cordial vote of thanks was then passed to Mr. Hailes for his services in the compilation of the new catalogue of slides.

Mr. Hailes thanked the members for the cordial way in which their thanks had been voted to him; he had carried out the matter to the best of his ability, and hoped that the catalogue would be found useful. He had been asked to call the attention of the members to a new form of lamp and shade by Messrs. How, a specimen of which was placed upon the table. He thought they would remember that about ten years ago he had himself introduced the white porcelain shade, which had since become so popular. He expected and hoped that some one would be able to improve upon it, but up to the present time no one seemed to have really done so. Now, however, he found that Mr. Smith, at Messrs. How and Co.'s, had improved upon it, and had produced a very pretty and useful lamp; it was smaller, and therefore more portable than the original one, and the shade being closed in at the top cut off the light there entirely. In reply to an enquiry as to its cost, Mr. Hailes said he was unable to state it, he had no interest in the manufacture, and could only refer to the makers.

The thanks of the meeting were voted to Mr. Hailes for his communication.

Mr. W. H. Gilburt read a paper "On the floral development of *Helianthus annuus*," the subject being illustrated by a number of diagrams.

The President said that he had been paying great attention to the paper which they had just heard read, and he must confess that as he did so, it had occurred to his mind to complain of a deception which seemed to have been practised upon him by their Secretary. When he was asked to become their President, he was told that they were not a scientific society in the severe sense of the term, but that they were largely made up of the amateur element. All he could say now was, that if *that* paper did not satisfy Mr. Ingpen, he must be very hard indeed to please. For his own part he might say that having dabbled in many subjects in the course of his time, amongst other things he had paid some attention to plant development, as he thought that there was no more instructive commentary upon animal structure than that supplied by vegetable growth. Indeed, he might say that the more important conclusions arrived at by such workers as Wolff and others were based very largely upon the study of the development of plants. He could not help saying that he had never heard a better paper, nor one which he regarded as a better piece of work, nor one which had been thought out on more philosophical principles than the paper which they had heard that night. It was one which must especially be instructive to every botanist, and he had been very much struck with the amount of thought and care evinced in its preparation. The President having invited observations upon the paper, and meeting with no response, remarked that there were two classes of papers which furnished very little in the way of discussion, those that were too good, and those that were too bad; it was the medium class of papers which afforded the best material for discussion.

Mr. John Hunter read a paper "On the Queen Bee and her fertilization," illustrating the subject by reference to an elaborately illustrated Italian work on the bee, and by the exhibition of living bees.

The President said that the whole subject touched upon by Mr. Hunter was wonderfully interesting. He (Mr. Hunter) certainly appeared to be one of those privileged persons who could handle bees with impunity. The story ran that if a black queen were crossed with a Ligurian drone then all the workers which were hatched from the eggs of that queen would have the Ligurian marks, but the drones would have all the characters of the black bee—perhaps Mr. Hunter could tell them if this were the case.

Mr. Hunter said that when an English queen had been crossed by a Ligurian drone it had been thought that this distinction could be made out, but the Ligurian drones were often so imperfectly marked that the distinction was sometimes doubtful. The drone was thought to partake of the character of the mother, but he believed the fact had never been satisfactorily proved.

In answer to an enquiry, Mr. Hunter said that the queen never left her home except to mate, and then she always flew quite away, sometimes as much as four miles.

A member enquired why it was that the drones were so numerous if the queens were so few in number?

Mr Hunter said it was no doubt in order that the chances of the queen meeting with a drone might be increased.

The President said he had been asked to announce that a paper was wanted for the next meeting. In this practice he thought he saw another part of this curious deception which had been practised upon him. In other societies a great deal of trouble had to be taken to secure papers for the meetings, but here it seemed they had only to intimate that a paper was wanted in order to get what they desired.

The President announced the engagements for the ensuing month, and the meeting terminated with the usual conversazione, at which the following objects were exhibited:—

Section of seed of Hemlock...	Mr. F. W. Andrew.
Adiantum cuneatum	Mr. W. J. Brown.
Anguinaria spatulata	Mr. C. G. Dunning.
Tongues of Sand Wasp and parasitic Bee, showing all the organs of the mouth without distortion or loss of colour	Mr. F. Enock.
Various Insect Dissections	Mr. F. Fitch.
Chœtoceros armatum from Ormsby...	Mr. H. G. Glasspoole.
Swan's feather, polarized	Mr. W. Goodwin.
Ovaries of Queen Bee	Mr. John Hunter.
Section of Upper Jaw of Mole, showing transverse sections of teeth	Mr. J. J. Hunter.
Glyciphagus plumiger, showing plumous hairs, which attain a greater development in this species than in any other acarus. Only one specimen has been previously found in England	Mr. A. D. Michael.
Section of brain of *Blatta orientalis*, showing distribution of nerve fibres, cells, &c. ...	Mr. E. T. Newton.

Melicerta ringens ... ... Mr. G. D. Plomer.
Spirogyra nitida in conjugation ... ... } Mr. J. W. Reid.
Batrachospermum moniliforme ... ... }
Ferns from the Coal Measures ... ... } Mr. G. Smith.
Hornblende granite from Cleopatra's Needle. }
Transverse section of Stem of *Jasminum nudiflorum* ... ... } Mr. H. F. Ward.
Larva of Beetle (?)... ... ... Mr. T. C. White.

Attendance.—Members, 99; Visitors, 26.

November 8th, 1878.—Conversational Meeting.

The following objects were exhibited:—

Dermis of Sponge, *Hymeniacidon caruncula*, showing porous membrane and irregular deposition of spicula ... ... } Mr. T. H. Buffham.
Moss from Tenby ... ... Mr. A. L. Corbett.
Zoophite—*Crisia eburnea*... ... ... Mr. C. E. Dunning.
English Trap-door Spider—*Atypus Sulzeri* ... Mr. F. Enock.
General Anatomy of the Drone-fly, showing nervous system and respiratory organs. } Mr. F. Fitch.
Section of capitulum of *Helianthus annuus* ... Mr. W. H. Gilburt.
Rhabdonema arcuatum ... ... Mr. H. G. Glasspoole.
Polyxenus ... ... Mr. W. Goodwin.
Conochilus volvox ... ... Mr. J. D. Hardy.
Horizontal section of upper jaw of mole, polarised Mr. J. J. Hunter.
Head of *Sabella*, mounted in fluid two years ago Mr. A. D. Michael.
Section of twig of *Clematis vitalba*, double stained Mr. F. H. Ward.

Attendance—Members, 50; visitors. 5.

November 22nd, 1878.—Ordinary Meeting.

Professor T. H. Huxley, F.R.S., *President, in the Chair.*

The minutes of the preceding meeting were read and confirmed.

The following gentlemen were balloted for, and elected Members of the Club:—Mr. Jas. W. Cafe, Mr. H. F. E. Drayton, and Mr. Ernest E. Sabel.

The following donations to the Club were announced:—

"Proceedings of the Natural History Society of Glasgow" ... ... } from the Society.
"Proceedings of the Belgian Microscopical Society" „ „
"American Quarterly Journal of Microscopy ... in exchange.
"Journal of the Royal Microscopical Society" ... from the Society.
"Annals of Natural History" ... ... by purchase.
"Schmidt's Atlas of the Diatomaceæ" ... ... „ subscription.
"Science Gossip" ... ... from the Publisher.

Models made by the late Rev. J. B. Reade, to illustrate his theory of beaded structures ...	Mr. Henry Lee.
Dredgings from Galway Bay	Col. O'Hara.
Twenty-four Slides	Mr. A. C. Cole.
Ten Slides	Mr. F. H. Ward.
Two Slides	Mr. H. G. Glasspoole.

One Photograph for the Album—Mr. Badcock.

The thanks of the Meeting were unanimously voted to the donors.

Mr. Henry Lee said that as the new Catalogue of Slides was now issued, it struck him that the time would be an appropriate one for members to look it through, so as to see where there might be some hiatus which they were able to fill up. There were probably still many specimens required to complete some of the divisions which members might be able to supply, and he would suggest that they should look through the catalogue with that object in view.

The President said that the subject which he wished to bring before them that evening was a sort of contrivance which he had recently adopted himself, for the purpose of making dissections. They would all be aware that in a microscope to be used for delicate dissections, certain qualifications were absolutely essential. In the first place they must have perfect steadiness, the stand must be firmly and well supported, and be of sufficient strength and weight to bear the pressure put upon it without moving. Next it must be of convenient height, so that in working the hands might get a steady support; it should fulfil these two conditions, and yet not be so large as to be clumsy. The next point was as to the lenses; they should be of such a form as to give a maximum of power, and yet at the same time afford sufficient distance between them and the object to admit of needles being moved freely to an angle of 60° with the surface of the plate, because the efficiency of the needles obviously depended upon the angle at which they could be used, and if a lens were made with a wide face it would very often interfere with the movements of the needles. Then there was another point of still greater importance—when a careful dissection had been made, it often became desirable to examine it with a much higher power than the one which had served the purpose of preparation, and provision ought to be made to enable as high a power as was desired to be brought to bear without disturbing the object, and this could only be done by placing a compound body above the simple lens. The President then exhibited the instrument which he had devised to meet these requirements, and pointed out that it consisted of a glass stage, having a large aperture in the centre, and mounted horizontally upon three supports, one of which was formed by the pillar of the body; in this way it stood with great steadiness, and was strong enough to bear considerable pressure. The lens was carried by an arm projecting from the pillar, and made to turn aside horizontally when required; focussing and illumination were managed in the usual way, but there was a slow motion in addition to the rackwork. In offering the instrument for discussion, the question would arise as to the best form of lens

to be employed, and he hoped to receive the opinions of the members upon this and other matters; but at present he used an ordinary low-power achromatic objective, made so as to slip into the arm without screwing; there was great convenience in thus mounting and using a simple lens. With the old doublet there was much difficulty in working comfortably, and whether a person could do so or not depended a good deal upon his nose, being specially troublesome in the case of those persons who had somewhat aspiring noses. In addition to the lens which he had placed upon the instrument, there was another belonging to it of half the focal length. Now, supposing they had made their dissection successfully, the point was how to be able to convert the instrument at once into a compound microscope without disturbing either the lens or the object. One of his aims in life had been to get microscope makers to abolish screws, which he regarded altogether as abominable inventions, and in this instance, the compound body had been made to slip over the outside of the socket in which the objective had been placed. This plan answered fairly well, but he thought it would be better to have it made to fit rather more easily, and to be secured by a bayonet joint, because, supposing that the power employed was not sufficient for the purpose, then inconvenience arose unless the body could be got off again with sufficient ease to ensure the object remaining undisturbed by any jerk or movement. With the improvement of the bayonet joint, it would be easy to remove the body, and having taken out the first lens and dropped in, say a one-eighth in., the body would go on again without any disturbance. He had the instrument before them made upon that pattern, to see how the thing would work; he had used it for the past six or eight months incessantly, and could certainly say that for his requirements it was the best thing he had seen, and he believed that with the little addition of a bayonet joint it would be as nearly perfect as any instrument of the kind could well be. He thought that all persons who had been occupied in making minute dissections would see that it had value, and met all the requirements of the most delicate work. He hoped that the members would examine and criticise it, and make any suggestions that occurred to them for its further improvement, for it was becoming of very great importance to examine thin sections and minute portions of dissections without subjecting them to any such disturbance as to cause the slightest alteration, and it was equally important to be able to bring to bear upon them under such conditions the highest powers that might be needed.

Dr. Matthews enquired if the President spoke of dissecting in water?

The President said that he referred to dissection in a very shallow trough, and by transmitted light.

Mr. Ingpen was sure that the members would feel highly indebted to their President for bringing this instrument before them. The question of dissecting microscopes had always been a difficult one, from the different requirements of various individuals, and in many cases there was too great a desire for cheapness. He added some remarks upon the best form of slow motion, and on the objectives most suitable for the purpose, and then called attention to a number of dissecting microscopes which had been in use at

various periods, and which had been kindly lent for the occasion by Messrs. Crisp, Swift, Crouch and Curties. Amongst these were the well-known "Quekett" dissecting stand, the Lawson Binocular was also interesting as an attempt to introduce the binocular principle; a very old one, lent by Mr. Curties, had the lens connected with the base by a number of short tubes with ball and socket joints; a large one made of wood, with a glass stage, was well known to their President (who said somebody had called it a "beetle trap"), it was very simple, and owed its origin to the Leoni form; two other forms were those devised by the late Andrew Ross; and one by Mr Swift was a sort of brass transcript of the original Quekett instrument, the stand of which was made of wood.

Mr. Crouch said the instruments on the table well illustrated the difficulties which microscope makers had to contend with in the matter of dissecting microscopes, for no two persons seemed to agree as to what they really wanted. As a rule, an optician was required to make a certain instrument to fulfil certain purposes, and was requested to make it for not more than £2 or £3, and for every dozen persons he would have to make two dozen alterations in the pattern. As far as the objectives went, there was not the slightest difficulty in making what had been mentioned; but until they could get observers to agree as to what they wanted, it would not be worth any optician's while to take up the subject.

Mr. Ingpen said that the question of cost depended very much upon where they went to get the thing made. The Ross dissecting microscopes cost, he believed, 4½ guineas, and with the doublets and accessories, it soon ran up to £10.

The President said he had one of that pattern about 30 years old, and believed that it cost the sum named.

Dr. Matthews enquired if the President had ever employed a binocular eyepiece for dissecting purposes?

The President said he must confess that he was rather heretical as to binoculars in such cases. What was really wanted was to have the object well lighted and well defined. For all ordinary purposes there was nothing better than a good watchmaker's eyeglass, because it was so readily adjusted to the work, and, with a good orbicularis, to keep it in its place, there was no trouble in using it.

Dr. Matthews explained that he meant the ordinary binocular eyepiece, and not the binocular microscope. Some persons had a difficulty in holding an eyeglass properly, and to meet such cases there was another plan for using a single lens, namely mounting it upon an elastic wire, which could be moved to or from the object as required, by the pressure of the head.

The President said that there was sometimes a little difficulty about holding the glass in the eye at first. When a person was beginning to do so, he was apt to indulge in a good deal of impatient ejaculation; because, when he got absorbed in his work, he forgot the eyeglass, and let it drop occasionally into the middle of his dissection.

Mr. Ingpen thought that a large spot lens would be found of value, so as to get a black ground for the illumination of delicate transparent tissues in

water, especially as it would not exhibit the disturbance of the surface of the water by the needles.

The President said that he generally used a black screen for the latter purpose. There was one other point upon which he should like to have the opinion of the Club, and that was upon the best way of illuminating things whilst working by daylight. He could not get on very well with the condensing lens, and found it rather troublesome; reflected light seemed to be the best, and he had often wondered if a polished hollow cone would be a good sort of thing to use.

Dr. Matthews said that the idea had occurred to him of adapting something like the "*speculum uteri*" to the purpose, which would resemble a Wenham's illuminator inverted. He thought it would answer very well with a lens inserted into the wide end; he was, in fact, on the point of having one made, to try.

Mr. Charles Stewart was sorry to say that he must differ somewhat from their President as to the value of the binocular microscope in dissecting, for he had found it of the greatest use in the case of transparent objects, since it enabled him to recognise the precise position of one object above or below another, with a facility which he thought was of the greatest importance. He also wished to bring before them a little matter which he thought might be of interest, as it was in some degree connected with the subject which had engaged their attention. In making minute insect dissections, he had often found the want of a perfectly structureless background upon which to pin the object, and upon which it might be treated with spirit, and set aside to work upon at leisure. He had tried various things, but at length Mr. Field, of the Ozokerit Works, gave him a small quantity of black Ozokerit (or black wax as they called it), and this seemed to answer admirably, for it melted at a low temperature, remained soft enough to stick a pin into, and was absolutely unacted upon by strong alcohol, or water, or by any mixture of them. When required for use it was only necessary to put a few knobs of it in a saucer, and when it was warmed it flattened out over the bottom with as smooth a surface as could be desired. There were two sorts of it, one being a little harder than the other—he had brought some specimens of each with him to the meeting, both in the lump and run out in small saucers; the rims of these little saucers being ground off flat, a glass cover could be laid over them, and the contents would be preserved from dust, and, in a great measure, from evaporation also. One very great advantage about this stuff was, that there was no stain to come out of it; if gutta percha was used, the spirit extracted a kind of gummy product from it, a stain came out of it, and it very soon became brittle, whilst even the best cork contained numerous small cells, which got out after a time, and seemed to have a peculiar proclivity for attaching themselves to the most delicate nerves and filaments. The new substance seemed to him to fill a want, and it was equally useful for large dissections, as it could be made to line a trough with very little trouble.

The President said it struck him that the idea of using this material was a very important suggestion, and he could see at once that, in comparison

with it, gutta percha and cork were hopelessly out of court. He had himself used paraffin or wax. It was certainly a great advantage to have it black, as attempts to blacken paraffin generally resulted in getting some portions of the surface well coated, but others not covered at all. Then again as to pins; he thought a great deal of the fact that pins would stick into it so well; with paraffin the sides of the hole did not seem to close upon the pin as they ought to do, and so a very slight tension disturbed it, and by-and-by the pin became loose, and then the dissection became disturbed. With this new wax it was not so, there was a sort of elasticity about it which caused it to shut upon the pin and enabled it to bear the strain. He should also be glad to know where these convenient little saucers, shown by Mr. Stewart, were to be obtained?

Mr. Stewart said they were to be found at the corners of the streets, containing three whelks or three mussels for a penny. He bought those he had brought to the meeting at a shop in the New Cut, where they were supplied to costermongers.

Dr. Matthews said he had used heel-ball, such as was used for taking rubbings of brasses with; when this was melted it answered very well.

Mr. Stewart rather fancied that there was rosin in the heel-ball, and if so, they could not use it in contact with spirit.

Mr. Thos. Spencer said that such was the case.

Dr. Matthews said he mentioned it because in case of failure to get the ozokerit, the heel-ball would be found a good substitute, though, of course, it would only do for use with water.

Mr. T. C. White enquired whether a supply of this substance could be got by members of the Club, and at what cost?

Mr. Stewart said he thought it was worth about 10d. or 1s. a pound; he had not the slightest doubt but that it could readily be obtained if required, especially as Mr. Field was himself a scientific man. "Black wax" was the name they called it at the works. It was soluble to some extent in benzine or turpentine.

Mr. Hailes said it was a substance very well known now in commerce. It was a kind of native or mineral wax, and was found in Bohemia in large quantities, and now that it could be bleached it was used very largely for making candles. It was found in lumps, and was melted and run into casks for exportation.

Mr. Thos. Spencer thought that if the material itself was subjected to a bleaching process, possibly this black stuff might be some kind of residuum.

Mr. Pearson believed that there were some specimens of it, in its native condition, at the Geological Museum in Jermyn Street, and if he remembered rightly, they were of a very dark brown colour.

Mr. Ingpen had very little doubt that since the value of this substance for microscopical purposes had been so prominently pointed out, the opticians would soon be able to supply it to those who wanted any. As regarded the best methods of illumination, condensers were by no means so good as reflectors, especially by daylight, when the concave mirror belonging

to the microscope would form a very good illuminator for opaque objects. For those persons who could not comfortably use the binocular dissecting microscope, he should recommend the use of a large spot lens as an illuminator, which they would find of great use in showing the relative positions of the various portions of a semi-transparent substance viewed by transmitted light.

The President having proposed a vote of thanks to those gentlemen who had so kindly sent specimens of dissecting microscopes that evening in illustration of the subject they had before them, it was put to the meeting, and carried unanimously.

Dr. Matthews said he was rather taken by surprise at the proceedings having terminated so abruptly, but rose to do what he had intended to have done earlier, namely, to propose a hearty vote of thanks to their President for the very interesting communication which they had heard that evening.

The motion was put to the meeting, and carried by acclamation.

The President made the usual announcement of meetings, &c., and the proceedings closed with a conversazione, at which the following objects were exhibited:—

Seeds of *Epipactis latifolia*, showing loose reticulate testa, and minute embryo ...	Mr. C. Emery.
Head of *Nomada lineola*, a parasitic Bee, prepared without pressure, showing all the parts of the mouth, without distortion or loss of natural colour	Mr. F. Enock.
Tip of Blow-fly's tongue showing the teeth in relief	Mr. F. Fitch.
Macrospores or spore-cases (?) from coal	Rev. T. W. Freckleton.
Section of capitulum of *Helianthus annuus*, showing development of ovule	Mr. W. H. Gilburt.
Cuticle of Maize, polarised	Mr. C. Le Pelley.
Lissajous' Curves, ruled microscopically on glass, showing apparent solidity of figure ...	Mr. H. J. Roper.
Ear of Lobster, showing otoliths, filaments, and auditory nerve	Mr. J. Slade.
Nicothœ, an epizoön from gills of Lobster ...	
Ruscus aculeatus, Butcher's Broom, section of stem	Mr. F. H. Ward.

Attendance—Members, 91; Visitors, 9.

On a New Method of Preparing a Dissected Model of an Insect's Brain from Microscopic Sections.

By E. T. Newton, F.G.S.

(*Read January* 24, 1879.)

The structure of the nervous centres of Invertebrate Animals is a subject which is attracting some attention at the present time, and I have myself been much interested in the study of the Insect's Brain; but have found some difficulty in clearly comprehending the forms of certain of the internal parts. In order to get a better knowledge of these forms, I was led to construct a model, on a principle which I believe to be entirely new. Knowing the interest which our honoured president and the members of this Club always take in new methods of working, I felt constrained to bring the matter before you, and it is the purpose of the present paper to describe the manner in which this model has been constructed. Whether the method will prove available for other objects, time alone will show.

It will, perhaps, be desirable, before commencing the description, for us to call to mind the general form of an insect's brain. Some of us endeavoured on our last "Gossip night" to get a general knowledge of the anatomy of an insect, and, with regard to the nervous system, we noticed, that the most anterior pair of ganglia, which is placed in the fore part of the head, is joined by two large commissures to the second pair, which is placed lower down, and towards the back part of the head. Through the ring thus formed the gullet, or œsophagus passes, and hence the anterior ganglia, being above, are termed the *supra-œsophageal ganglia*, and the second being below, are called the *infra-œsophageal ganglia*. The positions of these parts is very well shown in the diagram of these ganglia, taken from a Mole-cricket (Fig. 1). The upper ganglia present two rounded prominences above, from the sides of which the optic nerves are given off (*op*), while at the top are seen two ocelli. Somewhat lower down, and towards the front, are two other prominences, from which the antennary nerves pass off (*an*). A little lower down a nerve is given off from each side, the two joining in the middle line to form the frontal ganglion (*f g.*); from this a single nerve passes

backwards along the upper surface of the alimentary canal. Below and behind the large commissures (*cm*) pass to the lower ganglia (*lb*), and, being long in the Mole-cricket, the two pairs of ganglia are well separated. In some insects they are much closer together.

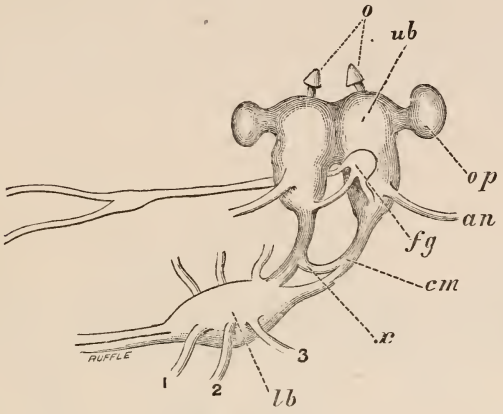


FIG. 1. — Brain of Mole-cricket, after Dietl. — *ub*, upper division of the brain, or supra-œsophageal ganglia; *lb*, lower division of brain, or infra œsophageal ganglia; *cm*, commissures between upper and lower divisions of brain; *x*, a cross-band of fibres peculiar to mole-cricket and some other insects; *an*, antennary nerve; *op*, optic ganglion; *o*, ocelli; *fg*, frontal ganglion of stomato-gastric nerve; 1, 2, 3, nerves to mouth organs.

From the lower pair of ganglia the nerves are given off which supply the mouth appendages. The researches of Faivre, in 1857 ("Du Cerveaux des Dytisque dans ses rapports avec la locomotion." "Ann. d. Sci. Naturelles. Zool." tome 8, p. 245) seem to show that the power of co-ordinating the movements of the body is lodged in the infra-œsophageal ganglia, and, therefore, it is not without reason that some authors regard these as a part of the brain. What follows in this communication refers only to the supra-œsophageal ganglia, or, as I should prefer to call them, the upper division of the brain.

The general arrangement of the internal structures will, perhaps, be best understood by reference to the figure given by Leydig, of the brain of *Formica rufa* (Fig. 2.) ("Tafeln zur Vergleichenden Anatomie," 1864, t. 8, fig. 4). Upon each side there is a large central ovoid mass (*pl*), which has been termed the *primary lobe*, and this abuts in the middle line upon its fellow of the opposite side, while the optic nerve, with its ganglion (*op*), is given off from

the outer or opposite end. The optic ganglion itself is a very complex structure. The antennary lobes (*al*) consist of a number of large rounded masses, which have been called cells, but are really made up of a network of fine fibres. Above the primary lobe are seen the peculiar bodies, having the appearance of half-rings (*mb*), which have been called convolutions, by Dujardin. ("Sur le systéme nerveaux des Insectes," 1850. "Ann. Sci. Naturelles. Zool." ser. 3, tome xiv., p. 195), and have been compared to mushrooms.

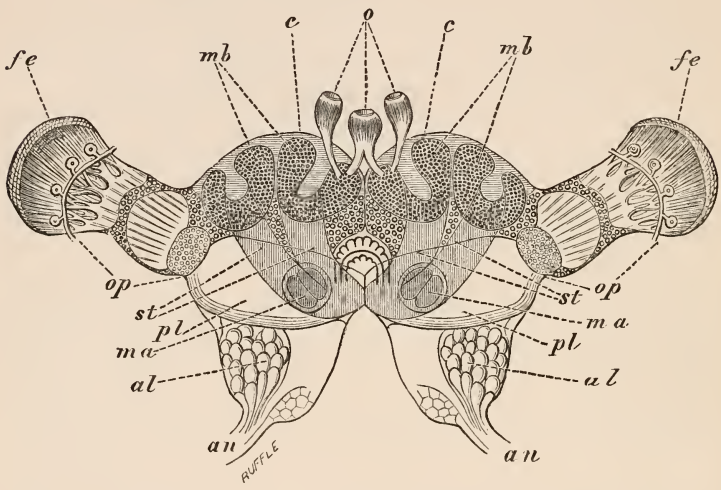


FIG. 2. — Brain of Formica rufa, adapted from Leydig. — *pl* primary lobe; *al*, antennary lobe; *an*, nerve to antenna; *op*, optic ganglion; *fe*, facetted eye; *o*, ocelli; *mb*, mushroom-bodies; *st*, stems of mushroom-bodies; *c*, cap of cells covering the mushroom-bodies; *ma*, optical section of the anterior mass of nervous matter.

Each of these mushroom-bodies is supported upon a stem (*st*) which passes downwards into the primary lobe, where the two lie close to each other, if they do not join.

The exact form of these mushroom-bodies is not easy to be made out from preparations such as that figured by Leydig, and, indeed, the appearance presented by sections does not convey a very clear idea of their form.

In the middle of the primary lobe, as figured by Leydig, there is a rounded mass, which he describes as a "giant nucleus" (*ma*), but more recent researches have shown that Leydig was mistaken, and that this appearance is really the optical section of a cylinder of

nervous matter, which passes forwards, to end abruptly upon the front surface of the brain. The structure was correctly described by Dujardin, in 1850, but does not seem to have been recognised by Leydig; this was, no doubt, due to the method of investigation employed by the latter, which consisted in clarifying the brain (previously hardened in alcohol) in potash solution, or glycerine.

With regard to the origin of the nerves of the ocelli (*o*), it is desirable that Leydig's figure should be verified, for it seems very improbable that they should arise from the heads of the mushroom-bodies in the Ant, and from a different part of the brain in other insects.*

Insects' brains vary very considerably as regards the development of the mushroom-bodies. In Ants, Bees, and Wasps they are proportionately large, and double on each side. In the Cockroach they are double, and moderately well developed, and in the Mole-cricket there is said to be only one on each side. Dujardin could not detect these mushroom-bodies in the Diptera; but recent investigations (E. Berger, "Untersuchungen über den Bau des Gehirns und der Retina der Arthropoden." Arbeiten des zoolog. Instituts zu Wein. Bd. I., Heft. II., p. 173) show that certain bodies exist in the Blow-fly (*Musca vomitoria*), and the House-fly (*M. domestica*), which, most probably, are correctly regarded as the homologues of the mushroom-bodies.

I had already prepared sections of the heads of several insects, some of which have been exhibited at our meetings, before I saw the paper by Dr. Dietl ("Zeitsch. f. wissenschaft. Zool." 1876, vol. 27, p. 488), in which some beautiful sections of Insect brains are figured and described. When I saw them I determined to try the method he had used for hardening the brains, namely, with hyperosmic acid. The insect which I selected to work upon was the Cockroach (*Blatta orientalis*). In the first place it was necessary to remove the brain from the head in a perfectly fresh condition, and this required some care, because the organ itself is extremely delicate, and if the investing membrane be injured the internal parts are apt to be squeezed out in the hardening process. The fresh brain, cleared from the surrounding parts, was placed for a few hours (6 or 8) in an aqueous solution of hyperosmic acid ($\frac{1}{4}$ to $\frac{1}{8}$ per cent.) It was then

* I find, since this paper was written, that according to Flögel, these nerves pass down beside the mushroom-bodies to the middle of the brain. ("Zeitsch. f. wissenschaft. Zool.," 1878, Vol. 30., suppl. p. 556.)

washed and laid in spirits of wine. The hyperosmic acid seems to me to be somewhat uncertain in its action, for sometimes the brains remained soft and unstained in the interior, while at other times the hardening and staining was most successful throughout.

The next point was to cut up the brain in a definite direction into consecutive sections of a known thickness.

So much has been said in this Club lately about section cutting, that it would only be wearisome to attempt to describe the process fully. It may, however, be mentioned that a microtome was used, in which the screw for raising the object was divided, so as to register a thickness of about the $\frac{1}{1000}$ of an inch. The brain was embedded in wax, in the usual manner, and each slice, as it was cut off, was placed directly upon a glass slip in a drop of glycerine, and numbered. When the entire brain had been disposed of in this way, the sections were cleared of the pieces of wax adhering to them, covered with thin glass, and cemented down.

The sections which appear to me the most instructive are those cut in a direction as nearly as possible parallel to the front of the brain. One brain, cut in this direction, gave me 34 slices, each about the $\frac{1}{1000}$ of an inch thick, and as no intermediate pieces were lost—although some were subsequently injured in the process of mounting—I had the whole of this upper division of the brain in a consecutive series of slices, and, therefore, in a very satisfactory condition for work. Any one who, in working out structures by means of sections, has endeavoured to trace the various parts through a series of slices, will understand how difficult it is to keep in mind the structures seen in each, so as to picture to himself the form of any part when entire. And still more difficult is it to convey to others the knowledge which one has gained by the examination of such a series.

Now it seemed to me that, if a drawing of each section of the series were made, and the corresponding portions in each coloured some definite tint, then the structures presented would be much more easily understood, inasmuch as they could all be laid before the eye at one time. I determined, therefore, to prepare such a series of drawings with the camera lucida, and the diagrams numbered 2, 4, 6, 10, 13, 17, 20, 25 (Fig. 3), represent the most typical sections of this series; only one-half of each section being here represented.

In section No. 2 may be seen, at the lower part, a portion of the antennary lobe (*al*). In the middle is a mass of nervous matter, here distinguished by vertical lines, and marked (*a*). Above this is a

cap-like portion, distinguished by horizontal lines (*c*). These are the portions which should be borne in mind in passing through the series.

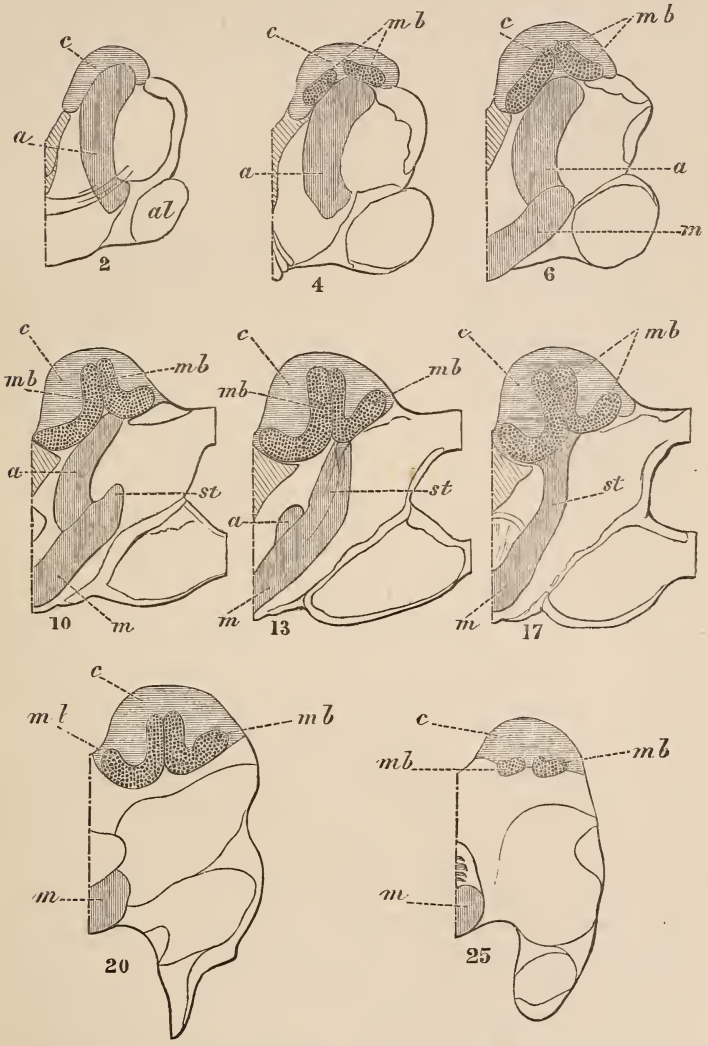


FIG. 3.—Diagrammatic outlines of sections of the upper part of the brain of a Cockroach. Only one side of the brain is here represented. The numbers indicate the position in the series of 34 sections into which this brain was cut. *mb*, mushroom-bodies, with their cellular covering, *c*, and their stems, *st*; *a*, anterior nervous mass; *m*, median nervous mass.

In No. 4 we find that while the parts noticed in No. 2 remain much the same, two dark masses (*mb*) have appeared in the upper portion, close to the mass (*a*), but definitely separated from it.

In No. 6 the dark masses have increased in size and become somewhat curved, but the most obvious difference is that the mass (*a*) has suddenly extended inwards and downwards to the middle line of the brain (*m*).

In No. 10 the dark masses are much more deeply curved, the upper portion of the mass (*a*) is rather less, and another process has begun to extend upwards and outwards (*st*).

In No. 13 the most important point to notice is that, while the inner mass (*a*) has almost disappeared, the outer one (*st*) has extended upwards, and may be seen to join the outer dark mass.

In the 14th section the outer mass (*st*) joins the inner dark mass also, and this junction extends as far as the 18th or 19th section.

In No. 17 the outer mass (*st*) may be seen joining both the dark masses, which are here very deeply hollowed out.

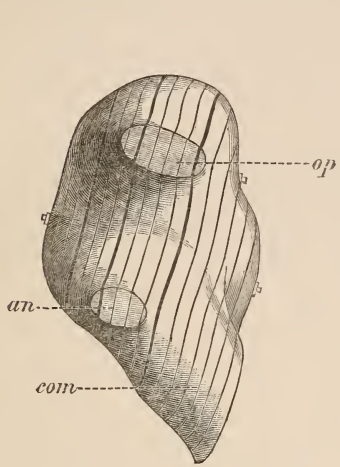
In No. 20 the outer mass has entirely disappeared, and we have simply a small portion of the lower mass (*m*) left close to the middle line, the dark masses are somewhat smaller. The extension (*com*) seen just below the antennary lobe is the commencement of the commissure to the lower division of the brain.

In the sections which follow, all the parts above-mentioned, excepting the commissure (*com*), get gradually less, and the dark ones are seen, for the last time, in section No. 25. The median portion (*m*), however, may be traced to the 28th section.

The next step in the process was this : It occurred to me that, if the card, upon which these outlines were made, were of a thickness proportionate to the enlargement of the drawings, and if each were cut out, and the whole piled together, one ought to have a model of the exterior of the brain. I set to work, therefore, to do this, but in order to lessen the labour as much as possible, it being merely an experiment, it seemed desirable to make one half first, and instead of making models of the whole series, the thickness of each slice was doubled, so that it was only necessary to make 17, taking, as a pattern, every alternate drawing.

The material used was soft pine-wood, each piece being about the $\frac{1}{8}$th of an inch in thickness. Having cut out each model slice with a fine saw, the whole were piled together in their relative places and temporarily fixed, so that the corners might be trimmed off, and the result was the form which is seen in the model of one-half of the

upper brain (Fig. 4). The different slices, however, were not left fixed together, but were separated and arranged so that they might be taken to pieces, as in the process of cutting sections, and the surfaces thus exposed were coloured to represent the sections as they appear under the microscope.



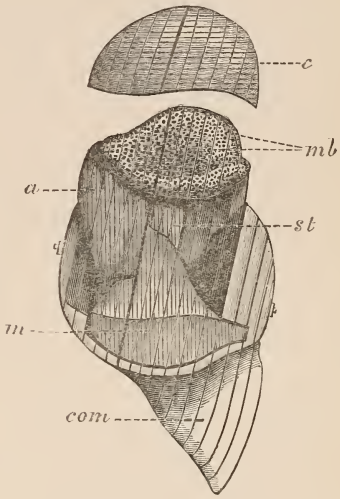


FIG. 4.—View from the outer side of the left half of model of upper part of brain of Cockroach. The oblique lines in this and Fig. 5 indicate the successive slices of which each is composed. *Op*, cut end of optic nerve; *an*, cut end of antennary nerve.

FIG. 5.—Right-half of model-brain seen from the inner side, with the parts dissected away, so as to show, the anterior nervous mass, *a*; the median mass, *m*; the mushroom-bodies, *mb*; and their stems (*st*). The cellular cap, *c*, has been raised, so as to display the parts below; *com*, is a part of the commissure to the lower portion of brain, or infra-œsophageal ganglia.

This method of modelling was capable of still further development. Having modelled the opposite half of the brain upon the same plan, I drew upon each of the model sections, thus produced, the outlines of the more important parts, as shown in the diagrams (Fig. 3), and these were then cut out in the same manner as a child's dissected map-puzzle. Now it will be obvious that by taking from each of these "dissected" sections, the part, for instance, which is in the diagrams (Fig. 3), marked (*c*), and joining them together in their relative places, we shall have a model of that particular part; and by joining, in like manner, the dark masses, and

those marked (*a*), (*m*), (*st*), we shall obtain models of the mushroom-bodies, with their stems, &c. In this manner the dissected portions of this side of the brain were joined together, and, after some little trouble in adjustment, one was enabled to make the parts fit together in their relative places. We have now, therefore, upon the *left* side, a model which may, so to speak, be cut up in slices, to show the microscopic appearance of the sections (Fig. 4), and on the right side, a model of the more important internal structures, which may, as it were, be dissected out before a class of students (Fig. 5).

I was in hopes that, before reading this paper, I should have been able to coustruct a similar model of the Brain of a Bee, in order to verify the descriptions of Dujardin, Dietl, and others, who have worked at this insect, but have not yet had the opportunity. This, I may say, however, that an examination of this model goes far to prove the correctness of their descriptions, for we see here a mass of nervous matter ending abruptly on the front surface of the brain, this extending backwards, and being joined by the stems of the mushroom-bodies, and reaching nearly to the back of the brain, after being gradually reduced in size. The heads of the mushrooms are seen to be, as described originally by Dujardin, discs folded upon themselves, and bent downwards before and behind. No doubt the forms of these parts differ in the Bee and the Blatta, but still, in their principal features, they are much alike.

I cannot help thinking that, a model such as this gives a far better idea of the true form of the internal parts, than it is possible to obtain from a study of sections alone, and, indeed, even if these minute structures are dissected out, there is great fear of their being distorted in the process. But, after all, the great use of such models is to enable the lecturer, or demonstrator, to convey to his students a correct knowledge of the parts under consideration, and I trust that this model may be the means of enabling some of us to comprehend, more easily than we otherwise should, the complex structures of an Insects' Brain.

On the Urticating Threads of Actinia parasitica.

By Francis Alfred Bedwell, M.A., F.R.M.S.

(*Read January* 24th, 1879.)

Plate X.

The line of the Dorsetshire coast near Swanage, magnificently iron-bound though it is to the westward, nevertheless affords from Durlstone Head eastward and northward, to Studland Bay, a fair hunting ground for seaside study. When I first saw an urticating thread it was at Durlstone Head. I was seeking microscopical objects there, when a small pool attracted my attention; it displayed a score or more of white filaments, which radiated to every point of the compass, from some central object that lay concealed at the bottom of the pool. I had no sooner seen them than the first returning wave of the flood tide filled the pool and obliterated the sight; it puzzled me exceedingly at the time, as I was quite ignorant of its meaning, but, as I found out soon afterwards, the filaments were the urticating threads (Acontia, Gosse) of *Actinia parasitica*. This actinia, as is well known, attaches itself to the whelk shell, which the hermit crab inhabits, and it is carried by the crab into the lobster pots, which are laid in deep water along that coast. It is not remarkable for that outward splendour which makes some of these creatures such delightful studies externally; but it has some excellent qualities recommending it to the student; one is that it rarely keeps its beautiful disc closed for long, while it carries about 50 of these threads; and they are organs of extraordinary interest. A thread varies from ten to four inches in length — fine as very fine sewing thread, and yet strong enough singly to bear the weight of actinia, crab and shell, and draw them up to the surface of the water without breaking; the threads are greasy to the touch, and ooze through the fingers, however tightly held. If a piece is cut off and examined under the microscope, it is seen to be literally a crowded mass of elliptical capsules, all set with the long axis radiating to a central longitudinal axis, so as to give (as I suppose) an imaginary transverse section

as seen in Plate X., fig. 1. The thread is very richly ciliated, and even when severed from the animal, still it moves—in graceful curves —here and there—stealthily returning on itself, but never at rest. Sometimes it makes a perfect coil like the ropes on a man-of-war's deck, and quite as truly laid ; but its favourite attitude is seen in fig. 2, and is that of a perfectly regular spiral ribbon.

I had been watching its movements one evening for some considerable time in wonder at its function, and amazement at its beauty, when I was enlightened in a moment as to what it was and what it could do. In the small glass slide with it was a lively little annelid, making its perpetual figures of S—first this way and then that. In an unlucky moment it touched the coil. Now its gyrations had been lively before, but the touch made them frantic—and there was cause—for from out the thread there flew at the worm a blinding mass of capsules, each with a short thread projecting from it, and the whole accompanied by a sticky fluid. See fig. 3. The writhings of the worm only brought it into fresh contact with the thread, and each contact served only to bring out a fresh supply of capsules and fluid, while some of the former stabbed the worm in the characteristic manner ; and even if the worm could have escaped from its murderous opponent, it would but have carried with it a viscous web of capsules and slimy fluid, so fine and delicate, and yet so tenacious and compact, that no mere exertions of the animal would probably have relieved it from the terrible net. That the animal was "stung" (to use the only word which will express its gestures) I have but little doubt, and although the character of its movements and of its very efforts to escape actually placed it at a great disadvantage in this extraordinary contest, still it was not paralysed. I released it from the thread, and it was none the worse, except that it was stabbed here and there by capsules.

The second encounter that I witnessed was of a still more terrible nature. Close beside the coil there was a small organism, with a molluscous like tail, that oozed along the glass just as a snail or amœba moves. See fig. 4. Its length was about a quarter of an inch. The progress of this adventurous animal took it straight over the coil, and with its soft tail it oozed transversely on to the thread. It was really painful to see what followed. Not a capsule disturbed itself, and yet the worm simply went to pieces ; it was torn to fragments, entirely disintegrated, while the coil softly moved onwards, disarranged in no way whatever.

But a third instance was even more remarkable still ; it was the case of an annelid, about three-quarters of an inch long. See fig. 5. Its head is represented in fig. 6. The coil gently passed over the lower rings of the worm's body. The eye could distinguish the glisten of the ciliary apparatus as it seemed deceitfully to woo the body of the worm, and the worm moved on wholly unaffected by the contact ; but at last the thread reached the head, and brushed that, and the worm then and there died. Not a capsule left the thread, yet the worm was killed. I removed it from the water, but it hung lifeless at the end of the forceps.

There was but one worm of those I saw attacked (if it can be called a worm) which was armour proof against this deadly foe, it was one which I have endeavoured to draw at fig. 7. It was about three-quarters of an inch long, and covered all over with cilia, and seemed to meet brush with brush, and it passed by and over the coil with perfect indifference.

Now the attitude of the thread in fig. 2 has no doubt suggested to the reader one, at least, of the uses which we may attribute to it, and the above facts, taken together, certainly, I think, bear out the idea that the thread is a fishing line—it destroys and it gathers in. If an animal protests against the contact, it is caught in a confining web of bewildering capsules and a maze of viscous fluid, which keeps it a close prisoner beside the thread, to be drawn in with the thread at the will of the actinia. If it remains quiescent it dies, either torn to pieces or paralysed. The thread of the screw acts as a ditch or duct, and the ciliary action sets up a strong tide of particles along it ; but for the accidental and fortunate circumstance, however, that I had seen the threads radiating in the pool at Durlstone Head, as already described, I should have hesitated to give this character to the organ, but that incident satisfies me that at times, at any rate, its functions are those now attributed to it.

The whole story of this Actinia is a most astonishing one—the fact that it takes to a carriage at all, the fact that it and the crab also must change carriages from time to time, as each successive shell proves too small for them ; the instinct that makes it always leave the opening of the whelk shell uncovered for the crab ; its possession and use of the acontia ; the story told by Mr. Gosse* of the parasitica

* "Actinologia Brit.," 115.

which found out the favourite haunt of the hermit crab in an aquarium, and waited its opportunity to slide off the rockwork on to his shell, are some of the instances of its extraordinary habits and gifts. But I became acquainted in 1868, at Swanage, with an incident connected with this crab and actinia, which may be of interest. I noticed that when fresh specimens were put into an aquarium the pair soon parted company, and the following morning the hermit crab would usually be found to be dead, with a wound in its side. On looking round for the enemy that had assailed him I found that most of the shells actually had a third inmate, in the form of a large worm (see fig. 8), which, with a most ferocious pair of jaws concealed in its body, had killed the crab. As to which of the triumvirate (if either) destroyed the whelk in the first instance, I do not pretend to say, but I strongly suspect one of the three did it ; perhaps not the actinia, as I have seen parasitica very contentedly riding on a shell with the whelk itself inside ; but, at any rate, here are three animals living in or on a house they never made, the crab dragging for all and digging for all, and the actinia, by the help of its fishing lines, picking up from the diggings of the crab the annelids, amœba, etc., that he disturbs, the worm (fig. 8) living on the leavings of the actinia, and then winding up the scene by eating into the crab, because he does not move fast enough, or because food gets scarce in a contracted aquarium !

I agree with Mr. Gosse that the threads are weapons of offence and defence, as the Actinia ejects them on irritation ; but there is this curious circumstance about them, that at last the animal gets accustomed to being touched, and will not eject them. And after a very little time, when I wanted to obtain a piece of thread for examination, I had to insert a crochet needle gently into the oval aperture and fish up one for myself. At first the animal resented this intrusion, and closed its disc, but it soon became accustomed to that also, and latterly never stirred when I introduced the needle. Undoubtedly the threads must assist digestion, even when within the body, by destroying and disintegrating the small living objects which are brought into the inner chambers by the constant currents to be seen passing in and out of the two little gristly-looking angles or channels (gonidia, Gosse), situate one at one corner of the oval aperture and the other at the other, and which are usually kept open, however closely the stomach walls may have come together and closed up the oval aperture.

Mr. Gosse says* that in form the thread is a flat narrow ribbon. I have never seen it in an attitude which gave me an impression of flatness. To my eye, it was usually cylindrical with a heart-shaped transverse section, and a cleft running along it longitudinally, and so I prefer to draw it. The attitude of the thread (fig. 2), indeed, gives, as I have said, the effect of a coiled up ribbon.

I must, in conclusion, apologise for the unscientific character of the language employed in this communication. I know how unsatisfactory this must be to scientific readers, but I have thought it best not to affect to adopt phrases or attempt a style with the use of which, personally, I am hardly if at all familiar.

DESCRIPTION OF PLATE X.

Fig. 1.—Transverse diagrammatic imaginary section of urticating thread (*acontia*) of *Actinia parasitica* × 100.

Fig. 2.—Favourite attitude of same thread × 40. There is a regular set of particles along the screw line.

Fig. 3.—Annelid (or *Turbellaria ?*) entangled in capsules and viscous fluid, discharged from thread (see text), × 8; size of capsules exaggerated.

Fig. 4.—Annelid (or *Turbellaria ?*), with soft molluscous-like tail, destroyed by thread (see text), × 16.

Fig. 5.—*Nereida* (?), destroyed by thread (see text), × 2½.

Fig. 6.—Head of ditto, × 10.

Fig. 7.—Unknown organism unaffected by thread, × 3.

Fig. 8.—*Nereis* (?) found in whelk shell with Hermit Crab and *A. parasitica*, × ½.

* "Actinologia Brit.," p. xxv.

On The Rotifers, by Dark Field Illumination.

By C. T. Hudson, M.A., LL.D., &c.

At the ordinary meeting, on February 28th, Dr. Hudson exhibited, in the Mathematical Theatre of University College, a large number of very beautiful transparent drawings, which being strongly illuminated from behind by lamps placed in a closed box, gave most faithful representations of the various rotifers as they appear under the microscope when illuminated with the paraboloid. The drawings were fully described, and the following is an abstract of Dr. Hudson's remarks.

Dr. Hudson commenced his observations by remarking upon the difficulties which beset any one at the outset who attempted to give a true definition of what a Rotifer was. This class of creatures had been variously described in different text books, but there had been no definition yet produced which would not be at once torn to pieces by the critic who attempted to make it apply to the whole group; for though it was easy to describe typical forms, the further one got from the central figure the more the definition had to be shorn of its positive assertions, until so many of the leading features were at length dropped that the only part of the original definition remaining might be that of "small creatures which laid eggs;" a distinction which, however, equally applied to hens and snakes. Instead, therefore, of attempting any universally applicable description, he proposed to show them a diagram of a typical Rotifer, and to explain briefly its distinctive structure. The room was then darkened, and Dr. Hudson proceeded to show as transparencies a series of admirably executed coloured diagrams as follows:—(1) *Brachionus pala*, as a typical form of Rotifer, showing cilia, water vascular system, alimentary system, reproductive organs, &c. In connection with this, it was pointed out that the whole family might be grouped into—(*a*) Those that swim and creep; (*b*) those that swim only; (*c*) those that are rooted for life to one spot; (*d*) those that both skip and swim. This plan

of division followed the classification of Dujardin, who, though an admirable critic, had done very little original work. (2) *Rotifer citrinus*—having the property of reviving again after being dried; the process of covering themselves with a gelatinous coating to resist drought, as explained by Mr. Hy. Davis—was referred to. (3) *Actinurus Neptunius*—one of the rarer Philodines. (4) *Hydatina senta*. (5) Some curious parasites found in the stomach of *Hydatina*. (6) *Notommata aurita*—its method of capturing and devouring Vorticellæ described. (7) *Trochosphæra æquatorialis*—rare foreign form. (8) *Pterodina valvata*. (9) *Euchlanis triquetra*. (10) *Lacinularia socialis*. Dr. Hudson remarked that it had been formerly held by Professor Huxley that Rotifers were the permanent forms of Echinoderm Larvæ. He need not trouble the meeting by following out the subject further than to say that the Professor's argument partly depended on the assumption that the Rotifers could be divided into a monœcious and a dicœcious group, and that *Lacinularia socialis* had been placed in the former. It was probable that Professor Huxley had since seen reason for modifying this conclusion, because male Rotifers had now been discovered in all the great groups, with one exception; and he himself (Dr. H.) had had the good fortune to discover, among several others, that of *Lacinularia*. As the Quekett Club was a working society, these missing males might be looked for by the members. They were those of the Philodines—common Rotifers that might be found in every gutter—and yet no one had yet seen and recognised their males. Suppose the Q.M.C. should take it in hand! (11) The male of *Lacinularia socialis*. (12) *Asplanchna* (male and female). (13) *Œcistes*. (14) A group of *Œcistes longicornis*. (15) *Limnias*—specimen procured at Nailsea. (16) *Limnias*—peculiar form. (17) *Limnias annulatus*—rare species. (18) *Cephalosiphon*—peculiarity mentioned of having its one large antenna on the wrong side of the body. (19) Diagram of a plant—*Ranunculus aquatilis*—to show the application of the method of illustration to botanical subjects. (20) Portion of plant, with red water mites; also to show application of this method of illustration. (21) Group—with *Melicerta*. (22) *Melicerta ringens*, in various positions; also small one commencing to make tube. (23) *Melicerta tubicolaria*—placed in a distinct genus by Ehrenberg. (24) *Flosculuria campanulata*—a most beautiful object upon a dark ground. Its method of capturing its prey was described, an

instance given of an apparent exercise of reasoning faculty in the case of an individual which had caught an object too large to be drawn into its mouth and too rigid to be safely grasped by the disc. (25) *Stephenoceros*—very rare in the neighbourhood of Bristol. (26) *Bowerbankia*. (27) Annelid Larvæ. (28) *Pedalion*, with its male. (29) Diagram of some of the ordinary things found at the sea-side, to show the applicability of the process of illustration to this class of subjects. In the course of his remarks, Dr. Hudson pointed out the great value of dark ground illumination in the examination of Rotifers, and gave some hints as to the means of successfully accomplishing it ; the essential conditions being perfect collimation, accurate focussing, perfectly clean glass slide, cover, &c., not too much water, and the absence of any extraneous matter either above or below the object. With regard to the preparation of his diagrams, he described them as being made of stout "endless" brown paper ; the outline of the picture was drawn upon this, and then cut out, and the space filled in again by pasting a piece of tracing cloth over it. The colouring was for the most part done by sticking on pieces of coloured tissue paper, the shading being effected either by additional thicknesses of tissue paper or by a brush ; paints might also be used at discretion to produce effects as required. The cilia were represented by small holes punched out of the cloth or paper with a fine punch about the size of an ordinary pin's head ; and the high lights were produced by cutting through the cloth and covering with tissue paper only.

On the "Micro-megascope."

By John Matthews, M.D., F.R.M.S.

(Communicated February 28th, 1879.)

Mr. President and Gentlemen,—I must confess to a considerable amount of reluctance to occupy the time of the meeting at this late hour, and after the very admirable and lucid lecture to which we have been listening. I will try, therefore, to explain as briefly as possible, the nature of the apparatus now before you, and perhaps the best way of introducing the subject may be to give you some idea of the course of reasoning which has led me to its construction. Within the last year or two I have been studying the mode of formation of, as well as the conditions which contribute to, the optical images produced by lenses, and one amongst other experiments I have tried is, whether the spherical dots (areolations?) on the frustules of certain diatoms, would give images of objects suitably placed before them, in the same manner as the lenses in the cornea of an insect. I found that they did so. I then tried various corneæ and diatoms, and as each afforded images varying in *size* only, and perhaps in definition, when examined by the same power, it next occurred to me that if I were to use a single and more perfect lens, a larger as well as more distinct image would be obtained. I therefore placed an ordinary objective—by means of a suitable adapter—and *having its front combination upwards*, either in the substage or on the ordinary stage, as might be most convenient.* I then found that I got a very perfect image of any object to which it was directed, when it was examined by the objective in the usual place on the

* Since the above communication was made, I have been informed, and have satisfactorily ascertained, that Drs. Curtis and Ward, of the United States of America, devised a very similar arrangement, and published it in the "American Naturalist" for Nov. and Dec., 1870, and Sept., 1871. Extracts from their papers will be found in the "Monthly Microscopical Journal" for 1871 and 1872. The method of application was in both cases somewhat ambiguous.—J.M.

body of the microscope. It was also erected and varied in size and definition with the power used, as also with the distance of the object.

But I soon observed not only that it was difficult to illuminate a translucent object placed below the stage, but that the distance to which that object could be removed, was practically limited by the height of the microscope above the table; unless, indeed, the instrument were placed horizontally, which was not a convenient position in practice. To remedy this, I thought of adjusting a translucent object or slide to the flat side of an ordinary condenser, in the usual place between the lamp and the microscope, so that its image might be reflected by the *plane* mirror upwards through the substage objective. This plan effected exactly what was required *by diverting the line of sight* in such a manner that it was possible to place the object at any distance, and its image being thus varied in size, might (or could) be *exactly* included in the usual field of the microscope, and when there, easily examined by objectives and eye-pieces of almost any power. By this simple plan the powers and uses of the instrument were immediately increased, practically without limit, as I will now proceed to show. The objectives of the lowest powers which have hitherto been used are the 5 and the 4 inch. Now, with the ordinary A eye-pieces, the diameters of their field of view are (about) ·5 and ·4 of an inch only, and so on with the other low powers —the field, of course, lessening in degree. But there are many objects, such as large sections of woods, insects, corals, and various other things, which it is often most desirable to see wholly, and then to examine in detail. This is obviously impossible by any means hitherto used, except the lantern and the erector. Of the former I need not speak. The uses of the latter are so limited, that it has met with very little favour of late years, although it is very useful where the object "requires any kind of manipulation," or "where an extensive and yet limited range of magnifying power is required without any change in the objective."—(Carpenter.)

By this new arrangement, the object suitably illuminated is placed *just* so far from the mirror as to fill, when examined by the usual objective, preferably a two-inch and A or No. 1 eye-piece, the *whole of the field exactly*. There is no doubt that, in principle, the microscope is thus converted into a telescope of any power that may be required.

The ordinary achromatic condenser has always been focussed by examining the image of the flame of the lamp, or that of the bars

of the window of the room when used by daylight. Here, then, was the germ of the invention lying unnoticed for want of development.

I believe that some time ago Mr. James Smith showed this method of using an objective on the substage, but, as I am informed, no more was done with the apparatus than to show opaque objects well illuminated, and its uses were thus much restricted, no mirror or prism having been used.

Lastly, on examining my plan of using the plane mirror critically, I found that, in every case, there was a slight confusion of the two images given by its first and second surfaces. In a large proportion of cases this is of no consequence, but in some it certainly does more or less impair the definition. I have, therefore, caused a right-angled prism to be fitted up in its place, the reflections from which leave nothing to be desired, either in definition or light. It will readily be seen how valuable this plan may become in drawing, the size and scale being wholly at command, and if the instrument be placed horizontally, neither mirror nor prism are required. I have called the instrument a Micro-megascope, because we have with it the power of either magnifying or diminishing an object at will.

On the Dual-Lichen Hypothesis.

By M. C. Cooke, M.A., LL.D., &c.

(Read March 28th, 1879.)

[Abstract.]*

"That hypothesis which is based on sound scientific knowledge is sure to have a corresponding value, and that which is a mere hasty random guess is likely to have but little value."—*Prof. Huxley Lectures* (1863), p. 67.

Truth has often been discovered by the aid of a hypothesis, hence the proposition of a hypothesis for the advancement of science is perfectly legitimate. Some hypotheses which have been proposed in the past have proved utterly untenable when they have been assailed ; therefore, before any hypothesis is accepted, it should be subjected to all possible tests. Any hypothesis which cannot suffer criticism is not worthy of acceptation. The dual-lichen hypothesis is worth very little if unable to meet all the objections which such an assailant as the present can urge against it.

Without contenting myself with reviewing the remarks of single individuals, I will rather go direct to the main source of the theory of which Schwendener is the author. In a few brief sentences the whole gist of the hypothesis may be summarized. Although at first only the group called the *Collemaceæ* were included, ultimately, as his views extended, he included all Lichens in the category of Algo-fungi. These are his words, "As the result of my researches, all these growths (Lichens) are not simple plants, not individuals in the ordinary sense of the word ; they are rather colonies, which consist of hundreds and thousands of individuals, of which, however, one alone plays the master, while the rest in perpetual captivity prepare the nutriment for themselves and their master. This master is a fungus of the class *Ascomycetes*, a parasite which is accustomed to live upon other's work. Its slaves are green algæ, which it has

* The full text of this paper will be found in "Grevillea" for March and June, 1879.—Ed. "Q.M.J."

sought out, or indeed caught hold of, and compelled into its service. It surrounds them, as a spider its prey, with a fibrous net of narrow meshes, which is gradually converted into an impenetrable covering; but whilst the spider sucks its prey and leaves it dead, the fungus incites the algæ found in its net to more rapid activity—nay, to more vigorous increase."*

In the volume "Fungi" in the International Scientific series, from page 10 to page 16, the theory in question is thus explained :—

"The two great points sought to be established are these, that what we call Lichens are compound organisms, not simple, independent vegetable entities; and that this compound organism consists of unicellular algæ, with a fungus parasitic upon them. The coloured gonidia which are found in the substance or thallus of lichens, are the supposed Algæ, and the cellular structure which surrounds, encloses, and imprisons the gonidia, is the parasitic fungus, which is parasitic on something infinitely smaller than itself, and which is entirely and absolutely isolated from all external influences."†

In plain words, the gonidia are algæ, and all the rest of the plant is Fungus. At first sight it would appear that the whole controversy centered itself upon the definition of two words. A certain plant, with a peculiar organisation, has been hitherto by general consent represented by the term *Lichen*, whereas some modern writers contend that it should be called a *Fungus*, differing only from other Fungi in its power of enclosing certain unicellular algæ within its substance. Shall these organisms still retain the name of *Lichens*, or shall they be called *modified Fungi?* This is really one aspect which the hypothesis assumes, that of the value of two words. The theorists, on their part, maintain that it is something more than a mere definition of terms which is required, but they claim to have it accepted that *Lichens* (as they are called) are identical with *Fungi* (as commonly understood), but with the addition of certain extraneous bodies called "gonidia," which are truly microscopic Algæ.

Some general objections to the hypothesis will afford evidence that there is still a broad space between the theorists and some of their opponents.

* Schwendener, "Die Algentypen der Flechtengonidien," p. 3, 1869.
† "Fungi, their nature, use," &c., pp. 11-12, 1875.

Are Lichens Autonomous Plants? Is it, or is it not, possible from the structure or the development of a plant to predicate with tolerable certainty whether that plant is within itself a perfect or complete plant or not? If we sow a seed under favourable conditions, preserving it from all external influences, and that seed germinates, produces a root, a stem, ultimately leaves, the flowers, with stamens and pistil, then in course of time, as the ovary matures, seed in all respects identical with that from which the plant originally developed; in such a case we should certainly conclude that the plant under examination is a complete and perfect plant, possessed of all the essentials for the reproduction of its species.

If, instead of following the plant through all its stages, we bring experience to our aid in judging of probabilities, we examine a plant possessed of root, stem, leaves, and complete reproductive organs, bearing perfect seeds, we may safely conclude that we are examining a complete and perfect plant. All these organs we know by experience are not essential to the perfection of fruit in all plants. In some the stem will be almost obsolete, as in the daisy, or without true leaves, but with leaves and stem fused into a foliaceous expansion, as in the duckweed; and yet there will be no suspicion that the plant is incapable of reproducing its species, thus proving itself a perfect plant (using the term perfect, as in the sense of completeness). Hence we may conclude that if a plant is capable of reproducing its species, when excluded from all external influences, by means of its own proper organs, we may assume such an one to be a complete plant, whatever modifications in structure may be present, and whatever secondary organs may be absent. Such plants, however minute or simple in structure, are entitled to rank as autonomous plants.

The spores of a species of *Peziza* germinate, producing root-like fibrils of great delicacy, and upon these arise small globose bodies which, as they grow, become perforated at the apex, ultimately expanding into a cup, which completes the vegetation of the little plant. It is simply a minute fleshy cup, with a fibrous base, by means of which it is attached to the matrix. A section of this cup exhibits the reproductive bodies, the ova (if such a term may be permitted) contained in elongated tubes, closed at the apex, and packed side by side. These spores, when matured, are capable of reproducing the form and character of the parent. Yet simple as

such a plant may be, no one has raised a doubt as to its being a complete plant.

Another simple plant, with similar cup-shaped organs, or receptacles, enclosing similar reproductive bodies, contained also in cylindrical tubes, but with other organs superadded, such as a foliaceous expansion, analogous to leaf and stem, or it may be some other bodies characteristic of the group to which it belongs ; and at once analogy leads us to the conclusion that this also represents a complete plant.

If we concede that the Duckweed is a perfect plant, and the *Peziza* also a perfect plant, then also the *Lichen* must be a perfect plant.

Are Lichens (exclusive of their Gonidia) identical with Fungi? The hypothesis in question assumes that the lichen consists of a fungus, enclosing certain foreign bodies, called gonidia. Hence then, lichens, irrespective of the gonidia, should correspond in all respects to the Fungi to which they are referred. The presence of these small organisms may be ignored in our comparison of the supposed fungus with the real fungus of our experience.

In comparing the general character of Lichens with the general character of Fungi, we may assume that we can arrive at some definite conclusion as to the probability of their identity. We can predicate nothing of fungi except what is confirmed by fact ; and any other organisms, to be affiliated to them, must agree in all main features with the known characters of the Fungi, or they can have no claim to be considered identical.

It will facilitate this comparison if we are enabled to limit the area, which may be done by accepting the limitation fixed by the Schwendenerian hypothesis that the Ascomycetous Fungi are meant when the term Fungi is used, and as the *Sphæriacei* have been virtually excluded by all advocates of the theory, it may be assumed, as has been admitted, that the *Discomycetes* are the special group of Fungi to which the Lichens are referred.

The *Discomycetes*, in their cup-like forms, are assumed to be identical with the apothecia of certain lichens ; nay, more than this, all Lichens, to whatever genus they may belong, in their totality, excepting only their gonidia, are affirmed to be Discomycetous Fungi.

" Lichens are perennial ; they grow very slowly, but they attain an extreme age. Some species, growing on the primitive rocks of the highest mountain ranges in the world, are estimated to have attained

an age of at least a thousand years ; and one author mentions, after the lapse of nearly half a century, having observed the same specimen of *Sticto pulmonaria* on the same spot of the same tree.*

On the other hand, the Discomycetous Fungi are annual, very short-lived, their whole existence being limited to a few weeks, rapid in growth, and rapid in decay, not a trace of some species remaining after a few days.

Lichens will exist under conditions of aridity which no other vegetables could support. Some are peculiar to calcareous rocks, a few are found on arenaceous rocks, many are common on the granitoid series, including micaceous, gneissic, granitic, and quartzose rocks, and *Lecidea geographica* is frequent on the purest and smoothest quartz.

Fungi, on the contrary, must have moisture for their very existence sake ; are mostly found in damp and shaded situations, and could never exist under the conditions just enumerated for Lichens.

The highest mountains, beyond the snow-line, at 16,000 feet on Chimborazo, the extreme limits of vegetation at the North and South Pole are occupied by Lichens. Dr. Hooker found three species of Discomycetes in the Falkland Islands, to 116 Lichens. The Reindeer Moss and species of *Umbilicaria* flourish amongst the snow. On the other hand, frost and snow are fatal to Discomycetous Fungi, which disappear long before the snow-line is reached on mountains, and even before phanerogamic vegetation in the direction of the Polar regions. Of all plants, Lichens support extreme cold most successfully, whilst Fungi succumb at the approach of frost.

Lichens which grow upon the bark of trees may be seen flourishing in profusion during the life and vigour of the tree. It has been affirmed that the portions of Cinchona Bark which have been covered with Lichens during growth abound in the Alkaloids, on which their medicinal use depends, † whereas the portions attacked by

* Dr. Lauder Lindsay, "Lichens," p. 52.

† Pharmacologists are aware that the most valuable kinds of Cinchona Bark, as, for instance, the "Crown Bark," are habitually covered with Lichens, and that this covering favours the development of the Alkaloids. Regarding this fact, the late Mr. McIvor, of Ootacamund, introduced the plan of covering the growing branches of Cinchona plants with moss, and the bark thus mossed produced a larger percentage of Alkaloids than the naked bark. The operation may be purely mechanical, such as obstructing the light. However this may be, certainly no injury is inflicted, but benefit is conferred by the growing lichens.

Fungi are valueless from the tissue being destroyed by the ramifying mycelium. Indeed, Fungi do not and cannot flourish on growing and vigorous bark, but on diseased, dead, or decaying spots.

Lichens obtain the greater portion of their pabulum from the atmosphere, and only their mineral constituents from the matrix. Hence they cover the trunks and branches of forest trees, without apparent injury, and many species habitally flourish on the hardest granite. Fungi, on the other hand, obtain their chief support from the decaying vegetable matter on which they flourish, gathering up a large store of the nitrogenous results of putrefaction and decay, and disintegrating the matrix on which they prey.

Lichens, in their chemical composition, contain a large number of substances which are wholly unknown amongst Fungi. Colorific principles, such as obtain in the Orchella weeds, Orcellic, Cetraric, Lecanoric, Tannic, and Gallic Acids, Lichenin, and even a peculiar and characteristic odour, all of which cannot be attributed to the gonidia they contain.

Lichens contain but a small percentage of water as compared with Fungi, so that in dessication they do not shrivel, collapse, or perceptibly diminish in size, whereas Fungi shrivel up and collapse so as scarcely to be recognised, becoming liable constantly to the attack of insects, or, if damp, subject to the development of mould, whilst Lichens may be preserved for years under like conditions without fear of insect or mould.

Lichens, when collected and cast aside without the slightest care or precaution, do not exhibit the least tendency to putrefy, whilst Fungi, with the utmost care in drying, can scarce be preserved from unmistakable evidences of incipient putrefaction.

Any one who has examined the thallus of such a Lichen as *Peltigera canina*, and compared it with any known species of the Discomycetes, must come to the conclusion that amongst them there is no such structure to be found as that which prevails in the Lichen thallus, altogether irrespective of gonidia.

It is sometimes useful and instructive on doubtful points to consult the instincts of the lower animals, and this course may be adopted with advantage in the present instance. Amongst *Coleoptera* there is an entire family called the *Mycetophagidæ*, many of which live upon Fungi, and yet do not attack Lichens. There are also some of the *Bostrichidæ* and some species of *Anobium* very fond of Fungi, but they do not attack Lichens. The insects which

destroy Lichens are few in number, and quite different in their relationships from those which prey on Fungi.

There is also amongst the *Diptera* a family called *Mycetophilidæ*, with like propensities, as evidenced by the genera *Mycetophila*, *Boletina*, *Mycetobiæ*, *Bolitophila*, and yet there are none so equally destructive or parasitic on Lichens.

These insects must have come to a sounder conclusion than some men, that Lichens are *not* Fungi, with the addition of an innocuous green Alga. Surely if they had the same grateful food to offer, these insects would patronise the Lichens ; but as they attack all kinds of Fungi, and do not attack Lichens, insects certainly have not yet become converts to the Schwendenerian hypothesis.

In concluding these comparisons, the only inference which appears feasible is, that all these differences are so many reasons against the identity of Fungi with Lichens. There must be a most essential difference between them, beyond the gonidia, for the gonidia are not sufficient causes to produce all these divergencies. It is quite erroneous to state, as some have done, that the gonidia constitute the only difference between Lichens and Fungi, whereas the presence of gonidia is only one out of the many differences which exist between them.

Are Gonidia a part of the Lichen-structure?—The thalli of Lichens enclose within them peculiar cellules, forming a sub-cortical layer, which are sub-globose, of a greenish colour, and to these the name of *gonidia* has been given. They frequently burst through, and appear on the surface, in the form of powdery masses. The lichenologist believes, and as he thinks has good reason for believing, that they form part of the plant itself. One says, " They may be regarded as intermediate in function between the vegetative and reproductive cell, assuming the offices and partaking of the characters of both."* The justly celebrated Tulasne considered them to be parts of the Lichen, and also to perform important functions. On the other hand, the theorists contend that they are no part of the plant, but that they are a form of Algæ, upon which the residue of the Lichen is parasitic. The grounds of the belief are suppositious, and the proof is still defective.

In the first place, it is argued that they are free cells, resembling in size, form, and colour certain low forms of unicellular Algæ, and

* Lindsay, " Loc. Cit.," p. 41.

hence, as they are out of place in Lichens, they must be unicellular Algæ.

Any one who has had any experience amongst the low forms of vegetable life, in which the organism consists of a single cell, are exceedingly well aware that it is almost an impossibility, from the observation of these cells, to arrive at any satisfactory conclusion as to what they are, and what their ultimate development may be. Let them compare, if they please, what are known to be the earliest stages of Mosses and Algæ with the gonidia of Lichens, and draw up characteristic diagnoses, if they can. All are globose cells containing a greenish protoplasm, and about equal in size. By what occult power can the theorists distinguish that which, it is admitted, they cannot describe? Yet the best and most experienced Algalogists affirm that of all these forms the gonidia of Lichens are the most distinct and permanent in their character.

The only safe method by which these low forms can be determined, is by watching their development. In their simple condition of cells they are no more than mere buds, the ultimate form of which only the rash or foolish would predicate.

If the gonidia of Lichens are true Algæ, it is insufficient to state that they so closely resemble Algæ that they might be mistaken for such; there must be some undoubted evidence produced that they are Algæ in fact, and not in appearance.

Nylander, on the contrary, holds that they are organs belonging to the Lichen. He says, "I have adduced that the gonidia and gonimia of Lichens constitute a normal organic system necessary, and of the greatest physiological importance, so that around them we behold the growing (or vegetative) life chiefly promoted and active." Again he says, "The absurdity of such an hypothesis is evident from the very consideration that it cannot be the case that an organ (gonidia) should at the same time be a parasite on the body of which it exercises vital functions."*

Now, it must be admitted that Dr. Nylander is the *facile princeps* of Lichenologists. If it can be shown that these green cells perform an active part in the life of the lichen—in fact, that they are organs possessed of certain functions, then they cannot at the same time be foreign to the plant in which they occur. Nylander has shown that, whenever they are few in number, a proportionate decrease of vitality

* Nylander, in "Grevillea," ii., p. 146, 147.

takes place. That the most vigorous functions of life are carried on in their proximity.

As the Schwendenerian theory is wholly based on the belief that there is no genetic relationship between the hyphæ and the gonidia of the Lichen thallus, any proof that such a genetic relationship does exist is fatal to it. Dr. Minks, of Stettin, has directed his attention specially to the investigation of this point with very important results. He discovers in the hyphæ of Lichens two new organs, which he has designated *geonangium* and *gonocystium*, which produce gonidia within the walls of the hyphæ themselves. These gonidia, because of their minuteness, he names *micro-gonidia*. He has seen these *micro-gonidia* in all the cells of the hyphæ, whether in the vegetative or the reproductive parts. He sees them in the cortical layer, the medullary layer, the paraphyses, the young asci, the sporidia, &c. Thus he has established their existence, not only within the hyphæ-cells of all parts of the Lichen, but also in all stages of its life-history.*

These facts, so utterly subversive of the Schwendener theory, have likewise been observed and confirmed by Dr. Müller, of Geneva, who says, "My results have surpassed my highest expectations. Not only have I proved the existence of micro-gonidia in all the organs mentioned above, after having treated them with caustic potash, sulphuric acid, and tincture of iodine, but I have also seen them with my excellent immersion objectives, without any chemical preparation; and in favourable cases, I have even seen them with the non-immersion lower powers of Hartnack." He proceeds to say that these micro-gonidia are paler than the ordinary gonidia, and disposed in moniliform series in the axes of the hyphæ, having a diameter of ·001 mm. In certain tropical species, which had been exposed to a more vivid light than those in more northern latitudes, these micro-gonidia attained a brighter green; for example, in *Parmelia prolixa*, var. *erythrocardia*, Müll., sent by Dr. Schweinfurth from Lake Nyanza, in Africa. In this Lichen they were so green that little difference of colour existed between them and the gonidia.†

If the "parasite" can produce within itself all which it requires

* Since the above was written some Lichenologists have rejected the conclusions deduced from Dr. Minks' experiments. Whilst contending that gonidia are organs pertaining to the Lichen, they consider them independent of the so-called *Micro-gonidia*.

† Consult Minks on Micro-gonidia, in the "Regensburg Flora," for 1878.

for its existence, then Nature has made a mistake in making it dependent on another being for its existence.

Here, then, we have clear demonstration that the gonidia are developed within the substance of the Lichen itself in a determinate and uniform manner ; that, instead of being altogether foreign from the Lichen, they are generated within it, and hence (according to the hypothesis) the parasite produces from its own substance the host upon which it is parasitic.

The admirable Memoir of Tulasne should be consulted in conjunction with Dr. Minks' contributions to the " Flora," and it will be seen that the latter confirms and amplifies the former, adding thereto new facts, and thus, doubtless, establishes the true relationship of gonidia to the residue of the Lichen.

Is Parasitism proven ?—A parasite is usually defined as an animal or plant which lives upon or attaches itself to another, and derives therefrom sustenance and support. The misletoe, which attaches itself to poplar and other trees, is a parasite. The mould which attacks and destroys potatoes, is a parasite, entozoa are parasites, and so also are the pediculi, and other insects which infest the higher animals. In ordinary conversation there is seldom likely to be any misconception of what is a parasite. In all known instances of parasitism, it is, I presume, admitted that the parasite thrives and flourishes at the expense of its host. In every known instance of parasitic fungi the fungus lives at the expense of its host, which it injures and ultimately destroys. Schwendener himself says, " the vine and potato fungus, as well as *all other fungi* which vegetate in living organisms, destroy their host plant, or host animal, in the unequal struggle." This universality of destructive parasitism in fungi knows no exception, and is, therefore, equivalent to a natural law. Any hypothesis which depends upon fungal parasitism, *must* of necessity recognize this fact, and conform to it. The fact cannot be reversed to save the hypothesis.

Our experience of fire, in whatever form it occurs, is that it burns or consumes that upon which it operates. We have no experience of fire which does not support itself by causing that change of form and condition which we term combustion. Hence we are justified by experience in rejecting any theory based upon a reversion of this fact, that is, on the assumption that fire does not consume.

Inasmuch as the supposed fungus, said to be parasitic upon the

gonidia, does not "destroy its host plant, in the unequal struggle," it cannot be a fungus, since, if it were a fungus, the gonidia would be destroyed, as demonstrated by experience. Or, if it were proven to be a fungus, then, not being parasitic, the gonidia are not foreign to it, but a portion of its substance ; and again a dilemma occurs, for no fungus is known persistently to enclose green granules. Relative size is another strong presumption against parasitism. In the Lichen we have a supposed parasite many times larger than its host. It is an elephant parasitic upon a flea, and not a flea upon an elephant. The parasite in the romance encloses and cherishes its host, which is buried within its substance, reminding one strongly of an entozoon, enclosed in the body of an animal, horse, dog, or man. In such a case it is not usual to call the man or the animal the parasite, and the entozoon the host, but the reverse. If it is urged that this is not an analogy, because the entozoon is known to subsist upon the animal in which it is found, then, in like manner I would urge that it is not proved that the gonidia do not subsist at the expense of the so-called fungus. In other words, it is more feasible to suppose that the assumed green algæ are parasitic than that they should be the host.

Again, if it can be shown that gonidia are part of the whole plant, they cannot be distinct from the plant. If they are produced *by* the healthy and normal action of the plant, then they are attributes of the plant. If they are beneficial to the plant, acting as organs, performing useful functions, then there is no more parasitism than in the leaves of an oak or the tendrils of a vine.

It is needless to recapitulate what has already been alleged that the gonidia *are* generated by the plant itself, and hence there can be no parasitism.

Dr. Nylander writes : "The absurdity of such an hypothesis is evident from the very consideration that it cannot be the case that an organ (gonidia) should at the same time be a parasite on the body of which it exercises vital functions ; for with equal propriety it might be contended that the liver or spleen constitutes parasites of the mammiferæ. Parasitic existence is autonomous, living upon a foreign body, of which nature prohibits it from being at the same time an organ."*

All conclusions as to the general character of Lichens, based upon

* "Grevillea" ii, p. 146.

experiences of the Collemaceæ, are essentially unsatisfactory. It is widely admitted, and has been for many years, that the Collemaceæ are aberrant forms of Lichens, even if they be Lichens at all. The genera *Collema*, *Leptogium*, *Synalissis*, *Myxopuntia*, *Omphalidium*, *Paulia*, *Lichina*, and *Myriangium* have been named together, as forming a group with the thallus of an Alga and the fruit of a Lichen. Some have excluded them from Lichens altogether, others have accepted them with reserve, as aberrant forms, and all this was done before any Schwendener hypothesis was dreamt of. Montagne and the Rev. M. J. Berkeley at one time were disposed to include all these genera under the name of *Collemaceæ*, as distinct from Lichens proper. (See "Lindl. Veg. King.," p. 49.) Cohn afterwards excluded them in a proposed arrangement. Hence we may conclude, that whether they are included with Lichens or not, they are aberrant forms, in no sense typical of Lichens, and cannot be held as evidence in any dispute as to the character of Lichens as a whole.

Weighed and found Wanting.—It only remains to sum up the evidence and apply it to the purpose for which the foregoing remarks were designed.

It is perfectly legitimate to construct an hypothesis with the view of ascertaining the truth, but it appears to me that such an hypothesis should be tested in three ways. It should be considered as demonstrated, on the one hand, or be rejected altogether, on the other, if it stands or falls by these three tests :

I.—We should be prepared to ascertain whether our hypothesis is consistent with existing scientific facts.

II.—Whether the hypothesis is sufficient to account for the phænomena in question.

III.—Whether the phænomena can be produced in any other manner.

I.—As to the harmony of the hypothesis with existing scientific facts. The assumption that two separate and distinct organisms are combined in one plant, which, by its own proper system of reproduction, is capable of continuing its species, each individual of its progeny also exhibiting the same phænomena of assumed dual existence, is inconsistent with known scientific facts, because, whilst one supposed plant proceeds from its proper germ, the other has none, and is, therefore, spontaneously evolved.

Thus, if the Lichen, by means of sporidia, is capable of pro-

ducing plants which are, in all respects, like the parent, then the sporidium of the fungus element reproduces also the algal element, and the same spore, or ovum, is the origin of two distinct and widely diverse organisms, *i.e.*, a fungus and an Alga, which is inconsistent with scientific fact.

The seed of the maple reproduces the Maple tree only, its parasite, the *Rhytisma*, establishes its parasitism afterwards by means of its own proper spores. Thus it is with other hosts and other parasites. If *one* germ is the origin of *both* the dual elements in a lichen, then these elements must both be considered as parts of a single individual.

The theory assumes, further, that a fungus is parasitic upon a smaller and weaker organism, which it does not injure or destroy. This, again, is contrary to scientific fact, as it confers upon, or assumes for, a destructive force, conservative powers.

The hypothesis assumes also that *all* the substance of *all* lichens, except the gonidia, are fungi, whereas, as has been shown, their structure, composition, habits, &c., &c., all differ materially from fungi, to such a degree, that they cannot be regarded as identical.

The hypothesis assumes also that the gonidia are certain forms of other plants, which they externally somewhat resemble, whereas the gonidia are organs of the lichen, performing definite functions in its behalf.

Hence, briefly, there remains no other conclusion but that the hypothesis fails to support the first test, because it is not consistent with existing scientific facts.

II.—Whether the hypothesis is sufficient to account for the phænomena in question. That is, whether the combination of a fungus and alga is sufficient to account for the production of a lichen, or to state the hypothesis in the phraseology of its advocates, whether a fungus parasitic on an alga is a sufficient cause to account for a Lichen.

Unless it can be shown that the fact of its parasitism is sufficient to alter the entire character of a fungus, it is *not* a sufficient cause to account for the existence of Lichens. Unless it can be admitted that parasitism will convert a fugitive, short-lived fungus into a perennial lichen, induce it to live on a dry, barren rock, which, as a fungus, it could never accomplish, to support great extremes of heat and cold, to submit to frost and snow without destruction, to flourish on growing trees, whilst still vigorous, and without induc-

ing decay, to assume a fibrous structure instead of a cellular, to produce certain acids within its tissues, which are unknown to it in other conditions, to exchange a putrefactive tendency for a persistent one, to abandon for ever a career of pertinacious destructiveness for one of inoffensiveness, in short, to reverse its entire character, unless it can do all these things as a result of parasitism on the minute green cells of an Alga, then the fact of such a parasitism is insufficient for the production of the phænomena.

Inasmuch as we have no experience of such a total change in the essential characters of fungi under any conditions of climate, or local circumstances, we cannot admit that simple parasitism will cause such a change. Numerous instances of parasitism are found habitually to occur amongst fungi. Many species exist in no other form than as parasites, and yet no alteration in the direction of lichens is known to take place. Therefore we are compelled to adopt the conclusion that the hypothesis is insufficient to account for the phænomena in question.

III.—Whether the phænomena can be produced in any other manner. It is almost needless to say much under this head, having already shown, as we proceeded, that all the phænomena of lichen life are wholly compatible with the assumption that these organisms are, in themselves, true, simple, autonomous plants. If, also, we are right in the conclusion that the hypothesis fails when submitted to the two preceding tests, the natural inference will be from the arguments already adduced, that all the phænomena which any Lichen exhibits are compatible with a simple organism. The Theorists admit, by their hypothesis, that all the phænomena, except the gonidia, are wholly compatible with a plant which they call a Fungus. Although we do not admit that *Fungus* is the correct name to be given to the plant, we also affirm that it affords evidence of being a simple plant, but with the addition of the gonidia, which we hold to be as possible as conidia enclosed within the substance of a *Fistulina* or a *Polyporus*, and not only possibly, or even, probably, organs of the Lichen, but that *positively* such is the case. We require no counter hypothesis, therefore, to support our view, but urge, on the contrary, that where an organism is seen to exist, and continues to reproduce itself in conformity with a certain type, it is folly to attempt, by multiplying causes, to account for phænomena in an abnormal manner, which can be readily accounted for by normal causes.

When we see an organism in possession of certain organs, which organs perform certain functions, however small, and these organs and functions are inherited and transmitted, there is a pretty strong presumption that all our efforts to demonstrate external causes, to account for phænomena already well accounted for, we shall only embark on a profitless speculation. At present there are still a few who are content with this view of the Lichens, and do not crave the novelty of a dual hypothesis.

As to the assertion that the hypothesis is now generally received and adopted, come from what quarter it may, it must be accepted for what it is worth ; even if endorsed by the " Nineteenth Century " it will certainly be forgotten in the twentieth. Such an hypothesis cannot practically be accepted whilst it is rejected by the Lichenologists and Mycologists. It must resolve itself into a question of classification, and so long as the best classificatory books are written by the best men, Lichens will continue to be Lichens, and Fungi much the same as they are.

PROCEEDINGS.

December 13th, 1878.—Conversational Meeting.

The following objects were exhibited :—

Head and Organs of Mouth of Drone Bee ...	Mr. F. W. Andrew.
Earwig—Polarised...	Mr. W. Goodwin.
Transverse section of Molar Tooth of Horse ...	Mr. J. J. Hunter.
Petiole of Chestnut—showing the horse-shoe arrangement of its air cells and crystals of mineral matter, *in situ* ...	Mr. A. Martinelli.
Two rare varieties of Madrepore ...	Dr. Matthews.
Corals on Sponges, showing parasitism	
Hooklets of genital organ of *Pontia brassica*, being in the female *only* of that species, and absent in the male	Mr. B. W. Priest.
Mantle lobes of *Terebratula caput-serpentis*, showing the calcareous spicules ...	Mr. J. Slade.
Aristolochia ornithocephala... ...	Mr. F. H. Ward.
,, *sipho*	
Sections of Broom...	
,, ,, *Tillandsia glaucophilla* ...	
Sections of *Wistaria*	Mr. T. C. White.
,, ,, Rose	

Attendance—Members, 57 ; Visitors, 10.

December 27th, 1878.—Ordinary Meeting.

T. C. White, Esq., M.R.C.S., &c., Vice-President, *in the Chair.*

The minutes of the preceding meeting were read and confirmed.

The following gentlemen were balloted for, and elected members of the Club:—Mr. Andrew Chatto, Mr. H. A. Erlebach, Mr. Frank C. Kellow, Mr. M. G. Martiney, Mr. John M. Reid, and Mr. C. W. Salmon.

The following donations to the Club were announced :—

"Proceedings of the Royal Society"	from the Society.
"Transactions of the Royal Microscopical Society"	,, ,, ,,
"Proceedings of the East Kent Natural History Society"	,, ,, ,,

"Science Gossip" ... ... from the Publisher.
"American Naturalist ... ... in Exchange.
"American Journal of Microscopy" ... ... „ „
"Annals of Natural History ... ... by Purchase.
"Specimens of an Infusorial deposit from Cym Bychan Lake* ... ... } from Dr. Solterforth per Mr. T. Curties.
Photograph of Mr. F. Oxley, for the Club album.

The Secretary said that he had been requested to announce the following Soirées, and to ask the assistance of those members of the Club who might be able to be present at either of them:—That of the Greenwich Microscopical Society would take place on Wednesday, January 8th, 1879; the New Cross Society would hold theirs on Tuesday, January 28th; and the South London Society's would be held at the Crystal Palace, on February 19th.

Mr. Charles Stewart made some highly interesting observations upon Lichens, which he freely illustrated by coloured drawings made upon the black board as he proceeded. After describing the important *rôle* in the economy of nature which was played by the tribe of Lichens, and pointing out their peculiar powers of resisting drought, their usefulness as pioneers for other vegetation, and their commercial value as a source of dyes and an article of food, Mr. Stewart stated that in order to obtain some clear idea of their structure it would be necessary to acquire a knowledge of that of certain low forms of Algæ and Fungi. *Nostoc*, an Alga found in the form of gelatinous material encrusting rocks, &c., was then figured and described, together with *Cystococcus*, a cellular form frequently found upon palings, &c. The general characteristics of the Ascomycetous Fungi were then explained at some length, and the minute structure of *Peziza* was figured and described, its reproduction and development being traced through their various stages. The apparently identical structure of the Lichens and Ascomycetous Fungi was next alluded to, and it was shown that the cellular formation of the lower Algæ was present in addition, from which the inference was drawn that both Algæ and Fungi had contributed to the production of Lichens. Some further drawings illustrative of this combined structure were then made, and the relation between them was pointed out with great clearness.

The Chairman said that the subject before them was one which no doubt would at first sight strike any one as being decidedly dry; but he was quite sure that, under the lucid treatment of Mr. Stewart, it must have become most interesting to all. As a class, these lichens were most beautifully dispersed, and it only required a leading hand, like that of Mr. Stewart, to make any one take an interest in them. He hoped that many would be induced to take up the subject. Having invited remarks upon the subject, he called upon Dr. M. C. Cooke to say something upon it.

Dr. M. C. Cooke said that he had, in the first place, to thank Mr. Stewart for the lucid, clear, and interesting manner in which he had laid before them a theory which had many supporters, and which had now extended itself

* A list of these diatoms will be found in the "Proceedings of the Chester Society of Natural Science," No. 2, p. 28.

pretty widely. But although this theory was widely extended and widely entertained, it was by no means to be concluded that it was therefore true. He thought it was quite fitting that, at a time of year when romance was held to be in fashion, this, one of the prettiest little bits of scientific imagination, should be brought before them. Nevertheless, he regarded it as being from beginning to end, root and branch, totally and entirely false, and without a single good fact to stand upon. In connection with this theory, three classes of scientific men were brought upon the tapis—the Algologists, the Lichenologists, and the Fungologists—but though it was said to have received the support of many, he made bold to say that amongst them all there was not a single one of real *eminence* who had ever supported it, but that it had been carried out entirely by intermediate men, and remained only a theory. It was very true that there was between these things much of external similarity, but there was no analogy—there was much theory, but no fact. He had, during his time, had some little experience as to fungi; there was hardly, in fact, a night on which he did not examine something like fifty of them, so that he might be said to know something about them; but directly he put his knife into a Lichen he knew what he had got, even if his eyes were closed, such an entire difference was there in the substance; and although there might be some sort of apparent resemblance, when they got them under the microscope it was evident directly what they were. He had also studied in his time the Peziæ, and knew something about them, and could therefore say that, although they appeared to be very similar upon the black board, yet there was between the things themselves as much difference as there was between the moon and what they sometimes saw in the cheesemongers' shops. He did not propose to deliver any lecture upon the subject, but merely took this opportunity of *protesting*, thinking it quite sufficient to say that he entirely disagreed with the theory, on his own part, and that he knew of no Fungologist of any note who did otherwise. Dr. Nylander did not accept it, and Leighton and Crombie both had shown that they saw no ground for it. It had, however, been put before the members of the Club by Mr. Stewart in a very admirable and interesting manner, and he congratulated him on having made the best that could be made of a very bad job.

Mr. Crisp said that the subject of Lichens ought to be a very interesting one to Microscopists, inasmuch as the exact position of the Cryptogam in the vegetable kingdom still afforded scope for extended and careful investigation which, for the most part, could be carried out only by the aid of the microscope. It had always struck him as very remarkable that amongst Microscopists there should be so many Fungologists and so very few Lichenologists. Lichens had up to recent times been a little studied and little understood class, and the student, as had been seen, found himself met by contrary opinions of various writers, without much, if any, guide to enable him to form an opinion as to whether they were Algæ or Fungi, or intermediate between the two, or what they were. With regard to Dr. Cooke's statement, it should be observed, that Sir Joseph Hooker, in his anniversary address as President of the Royal Society, on November

30, had pronounced in favour of the Schwenderian theory (passage read), which was strongly endorsed by Sachs, and confirmed by the results obtained by Bornet, Rees, and Stahl, who, proceeding synthetically, sowed Lichen spores on or near Algæ, and obtained thereby true Lichen thallus, and not only that, but in the case of the latter observer, it was demonstrated that the same Alga in connection with different Ascomycetes produced different Lichens. It might be of interest to the meeting if he were to describe briefly some investigations which had recently been undertaken by Mr. Babikoff and presented to the St. Petersburg Academy. If certain Lichens were examined, there would be found upon them oblong or orbicular tubercles, consisting for the most part of masses of gonidia, which were known under the name of *Cephalodia*. It had been suggested some years ago that these were an abnormal formation produced by algæ which had accidentally fallen upon the surface of the Lichen, and it was to ascertain the correctness of this view that M. Babikoff made a study of the whole life-history of the Cephalodia. By cultivating the gonidia, he found that they consisted of Nostoc containing Phycochrome, those of the Lichen itself containing Chlorophyll, and he was able to follow the progress of development from the earliest period down to the mature state of the Cephalodia. Mr. Crisp then, by drawings in coloured chalks, made by Mr. Stewart on the black board, showed (1) the commencement of the development of the Algæ by ramified hairs of the surface of the Lichen; (2) the stage of complete development, the hypha of the Lichen forming a continuous tissue with the Cephalodia, and the gonidia interrupted beneath the latter; (3) the more advanced stage showing the disappearance of these gonidia, and the conversion of the tissue of the Lichen beneath the Cephalodia into very interlaced hypha, which degenerate lower down into Rhizines; and (4) the final stage of separation of the Cephalodia from the Lichen.

Mr. Charles Stewart said he had very few more remarks to make; he could only repeat what he stated at first—that he had but slight practical acquaintance with the subject, though he certainly thought from reading that the balance of evidence was in favour of the theory that Lichens were cases of special Fungi parasitic on certain Algæ. That there should be some difference, he was quite prepared to find, but he was not aware that there was after all any radical difference; and certainly on comparing the Gonidia with known Algæ he thought that there was a remarkable resemblance. He had been particularly struck in examining the Lichens in the neighbourhood of London, where the complete development of the *thalli* (?) was arrested by the impurity of the atmosphere. Finding from examination of these Lichens that the Hyphæ and associated algoid cells were exceedingly like the Hyphæ of a Fungus and known Alga, he naturally came to the conclusion that the circumstance was in favour of the dual nature of the Lichen. There were just two other points which he would like to mention—one was with regard to the mode of growth in Lichens; sometimes the Alga element seemed to be in greater proportion than the Fungoid, and then the growth was

found to be very much like that of an Alga, but at other times the Fungus element prevailed, and the growing forms were accordingly more like the Fungi. The other point was that under ordinary circumstances the Gonidia were entangled, but had been seen sometimes to be fused with the Hyphæ; this was clearly explicable on the supposition of the latter being parasitic. (Diagram drawn showing the cell wall of the Hyphæ being fused with that of the gonidium.) Illustrative specimens were also exhibited under the microscope.

The Chairman thought the members would respond very heartily to a proposal that a vote of thanks be given to Mr. Stewart for his very interesting communication.

Dr. Matthews said that he had always thought it to be their duty, as well as their privilege, to appropriate, but with due acknowledgment, the labours of their predecessors and contemporaries. Now, there were two ways of doing this—there was the way which might be called with more correctness *mis*-appropriation, namely, that of the poet, who was described by the satirist as stealing his verses from half the town—

"But reading them damnably, made them his own;"

there was also the case of the man eulogised by the old Roman writer who—

"Touched nothing that he did not adorn;"

and this remark, he thought, might well be applied to their friend, Mr. Stewart. He thought that they were much indebted to Mr. Stewart for the very able and interesting manner in which he had brought this subject before them—personally, he felt much indebted to him for so doing. As regarded the theory involved in that subject, he was not prepared nor indeed competent to express any opinion; it might be *only* a theory after all, and yet it was supported by some very high authorities. Perhaps it was too soon to decide the question in one way or the other; but however that might be, it was one well deserving their attention. He had great pleasure in seconding a vote of thanks to Mr. Stewart.

The vote of thanks was then put to the meeting, and carried by acclamation.

The Chairman announced that, at the next gossip night, Mr. E. T. Newton would give an account of the General Structure of an Insect, and at the next ordinary meeting would read a paper upon "A Method of Making Models of the Brains of Insects from Microscopical Sections."

The meeting then terminated with the usual conversazione, at which the following objects were exhibited:—

Stem of *Synapta inhærens* (polarised) ...	Mr. F. W. Andrew.
Leaf of *Adiantum cuneatum*, stained and polarised	Mr. T. Curties.
Minute Diptera	Mr. H. E. Freeman.
Protococcus, showing its cell-division	Mr. A. Martinelli.
Cuttle bone	Mr. J. Slade.

Collema (apothecium and thallus) ...	Mr. C. Stewart.
Physeira, section of apothecium spore in asci and paraphyses	
Young Lichen, showing fungus, hyphæ, and gonidia	
Calicium, showing spores in asci ...	
Solorina, section of apothecium spore in asci and paraphyses	
Transverse section of French Honeysuckle ...	Mr. F. H. Ward.
Section of Tooth (polarised), showing layers of new bone, the product of inflammation	Mr. T. C. White.

Attendance—Members, 43 ; Visitors, 9.

January 10th, 1879.—Conversational Meeting.

The following objects were exhibited :—

Melobacia on Seaweed	Mr F. W. Andrew.
Pollen of *Myosotis disstiflora*, curious for its minute size (1-4,000 × 1-8,000 inch), and Dumb-bell form	Mr. T. H. Buffham.
Section of lower jaw of Mole	Mr. C. G. Dunning.
Sertularia argentea...	Rev. H. J. Fase.
Thrips *(Physopoda)*	Mr. H. E. Freeman.
Transverse section of Human Medulla Oblongata, measuring 1½ inch in diameter ...	Mr. J. J. Hunter.
Seeds of Carrot	Mr. A. Martinelli.
Damæus geniculatus— I.—Young larva in the act of escaping from the egg, showing the singular manner in which the long legs are packed in the egg II.—Larva—more adult—showing the mode in which it protects itself by a pile of dirt on the back	Mr. A. D. Michael.
Sponge Spicules, from Carboniferous Limestone of Ayrshire	Mr. S. H. Needham.
Dissection of *Blatta orientalis* (to illustrate his demonstration)	Mr. E. T. Newton.
Actinophrys sol—three in conjunction, and containing *Daphnia*	Mr G. D. Plomer.
Sponge Spicules, from root of a Coral ...	Mr. B. W. Priest.
Larva of *Comatula rosacea*, showing its mode of attachment to a seaweed ...	Mr. J. Slade.
Transverse section of stem of Misletoe and Apple Vertical „ „ „ Transverse „ Ovarium of White Lily	Mr. F. H. Ward.

Section of *Clematis vitalba*, double stained ... Mr. T. C. White.

Mr. E. T. Newton gave a highly interesting description and demonstration of the anatomy of an insect.

Attendance.—Members, 65 ; Visitors, 10.

January 24th, 1879.—Ordinary Meeting.

Prof. T. H. Huxley, F.R.S., President, *in the Chair.*

The minutes of the preceding meeting were read and confirmed.

The following gentlemen were balloted for, and duly elected members of the Club—Mr. Arthur Avery, Mr. George T. Barham, Mr. R. C. C. Bond, Mr. Julian Deby, Mr. Chas. W. Easty, Mr. Burcham Harding, Mr. Arthur H. Lancaster, Mr. James Murray, Mr. John M. Offord, and Mr. S. K. Wilson.

Eight gentlemen were proposed for membership.

The following donations to the Club were announced :—

"Proceedings of the Watford Natural History Society"	from the Society.
"Proceedings of the Chester Society of Natural Science"	from the Society.
"The American Naturalist"	in Exchange.
"Proceedings of the Belgian Microscopical Society"	from the Society.
"List of Publications of the Smithsonian Institute"	from the Institution.
"Science Gossip"	„ the Publishers.
"Annals of Natural History"	Purchased.
"Popular Science Review"	from the Publishers.
"Grevillea"	Purchased.
"The Midland Naturalist"	„
A large number of drawings and engravings of Sponges, with Pamphlets, &c., on the Subject	Dr. M. C. Cooke.
A Photograph of Prof. Quekett	Mr. T. Curties.

The thanks of the meeting were voted to the donors, and especially to Dr. M. C. Cooke for his valuable addition to the stock of drawings, &c., already presented by him to the Club.

The Secretary reminded the members that the Soirée of the South London Club would take place on Feb. 19th, and that he would be happy to receive the names of any persons willing to assist as exhibitors on that occasion.

Mr. T. C. White read a paper by Mr. F. A. Bedwell—"On the Urticating threads of *Actinia parasitica*."

Mr. White said he had frequently seen and examined these threads himself, and had generally found that they were projected from apertures of

those Anemones which were rough; such, for instance, as *Crassicornis*. He had sometimes seen them projected as long as 10 inches. In examining them he had done as Mr. Bedwell suggested, and cut off portions, and he quite agreed with him that the beads were rounded and ciliated, and crammed full of little dart-like needles. The plate in Mr Gosse's book would, no doubt, make this clearer than any explanation which he could give.

Dr. Matthews said there was one curious circumstance about the threads, which he thought worth mentioning; he had examined them under high powers, but not one vestige of muscular fibre could he find, and yet it seemed perfectly evident that they were actuated as much by muscular action as any other part of the organism. Another question of interest was, whether the poison, or means of offence, was of an animal nature, or whether it was electric—both had been suggested.

The President said that, though he was not familiar with the particular organism which formed the subject of the paper, he was very well acquainted with the corresponding organs of the *Hydrozoa*, the whole of which class were provided with apparatus of this kind. The so-called "Portuguese Man-of-War"—the *Physalia*—had the most formidable battery of this kind of any animal in the world, the tentacles hanging down some 7 or 8 feet long, and being beset with reniform thickenings, each of which was stuffed full of thread-cells. He was not surprised that there had been difficulty in observing the presence of muscular fibre, because, though it was there, it was probably all of an unstriped kind, and therefore somewhat difficult to make out. The question of the cause of the irritation produced by these thread-cells was a curious one; he thought, however, that they might put aside the idea of electric action, because the facts could be sufficiently accounted for without such a supposition. As regarded the *Physalia*, if any one felt inclined to try it they would find that the stinging sensation produced was much more severe than that of the worst stinging nettle they ever experienced; and if, whilst a person had his hand partially covered with these stinging organs, he happened to pass his hand over his face, the effect produced was of a most enlivening character. It was the outer layer of the tentacles which contained the stinging organs, each of which consisted of an elastic sac containing a long thread. When touched, the sac was turned inside out with surprising rapidity, and the small spine-like threads came in contact with the object which had excited the action—in the *Physalia* they would find thousands of these sacs. There was a curious question, however, as to whether the irritation produced was of a mechanical nature, or whether it was of a chemical nature—whether it was due to the excessive fineness of the threads alone, or whether it was not also aided by something of a poisonous nature contained within the sacs themselves. It might, perhaps, be remembered that there was an old trick sometimes played by schoolboys of putting cowage into one's bed which caused a good deal of uncomfortable sensation; it might be that the effect of the stinging organs in question was of this character, but he thought it also probable that the clear liquid contained in the sacs might have some-

thing to do with the effect, acting somewhat in the same way as that contained in the poison glands of the nettle. He did not know, however, that anybody had hitherto furnished sufficient grounds for arriving at a clear conviction that the effect depended upon either the one or the other, or both causes combined. There was no doubt as to the kind of effects produced, and their severity was in accordance with the size of the thread-cells inflicting them. It was possible to handle *Hydroïdea* provided with only small thread-cells with impunity, though even these were very formidable to small creatures which came in contact with them. The small fresh water *Hydra*, for instance, was apparently harmless, but if one of the small water fleas came within reach of its tentacles the effect was most marked and striking.

Mr. T. C. White said that Gosse mentioned a very curious instance, showing the penetrating power of these minute spines—he cut off with a razor a slice of the hardest skin from the sole of the foot, and presented it to the creature, when he found that even this hard structure was completely pierced through.

Mr. A. D. Michael said that this creature was pretty well known on the coast of Cornwall, where the fishermen had the greatest possible dread of it; and he had been assured by them that they sometimes had their arms rendered quite useless for days together after having been stung.

The thanks of the meeting were unanimously voted to Mr. Bedwell for his paper.

Mr. E. T. Newton read a paper "On a New Method of Preparing a Dissected Model of an Insect's Brain from Microscopical Sections," the paper being illustrated by numerous coloured diagrams, and by the exhibition of the model, and of prepared sections shown under four microscopes in the room.

The President, in inviting remarks upon the paper, observed that the method described by Mr. Newton was one of the most ingenious processes that had for a long time come under his observation. As regarded the brain structure of insects, these questions were all new, and it was very satisfactory to find that the study of them had resulted in the discovery of something more than it was the custom formerly to believe in. Because to him, at least, it was not satisfactory to think that bees and ants, with nothing but a little nervous pulp, were able to do things, apparently with intelligent purpose, which we, with our wonderful convolutions, had some difficulty in imitating. In the case of the cockroach, however, it was a little difficult at first to see what he did with so much brain, at least his capacities did not appear to have been fully recognised, though it might be that perhaps he was of a too retiring nature, or was he possibly "a mute inglorious Milton" amongst his fellows of the insect world? (The President referred to an amusing incident narrated by Mr. Moseley as having occurred on board the "Challenger," illustrating the sagacity and alertness of the Cockroach.) To speak seriously, this method of Mr. Newton's did seem to be a means of bringing before one's mind, not only the structure of insects' brains, but might also be applicable to the study of the highly complicated

structure of the human brain. If they could have models of that kind for the study of other kinds of brain structure, he thought it would be highly advantageous, and that knowledge of the subject would be correspondingly helped.

A vote of thanks to Mr. Newton for his paper was moved by the President, and carried unanimously.

The President announced that at the next meeting Dr. Hudson would deliver a lecture "On Rotifers, with dark field illumination," illustrated by transparent diagrams.

The proceedings then terminated with a Conversazione, at which the following objects were exhibited:—

Section of *Clematis*	Mr. F. W. Andrew.
Stictodiscus	Rev. H. J. Fase.
Cheyletus	Mr. H. R. Gregory.
Palate of *Trochus cinerarius* (?)	Mr. C. Le Pelley.
Section of Laurel leaf	Mr. A. Martinelli.
Parasite of Secretary Vulture	Mr. T. S. Morten.
Sections of Brain of *Blatta orientalis*, showing Nos. 7, 13, and 20, from a series of 34, and illustrating Mr. Newton's Model ...	Mr. E. T. Newton and Mr. J. Slade.

Attendance—Members, 83: Visitors, 18.

February 14th, 1879.—Conversational Meeting.

The following objects were exhibited:—

Pea Shell...	Mr. F. W. Andrew.
Flour Adulterated with Plaster of Paris ...	Mr. A. L. Corbett.
Cercopis sanguinoleuta, The Burnet Hopper ...	Mr. F. Enock.
Head of Bot-fly, *Gasterophilus equi*, showing rudimentary mouth	Mr. H. E. Freeman.
Section of Seed of *Phytelephas macrocarpa* Vegetable Ivory, showing cell-cavities and their canals	Mr. W. H. Gilburt.
Section of Bone of Tortoise, polarised... ...	Mr. W. Goodwin.
Horizontal Section of Foot of Human Fœtus ...	Mr. J. J. Hunter.
Crystals of Chloride of Copper	Mr. F. C. Kellow.
Albuminoids in Wheat	Mr. A. Martinelli.
Young Nymphs of *Gamasina* (in situ), parasitic on *Rhyphus nigricans*, a dipterous insect	Mr. A. D. Michael.
Stephanoceros Eichornii	Mr. G. D. Plomer.
Geodia Barettii, found at the Base of a Coral (*Stylaster*)	Mr. B. W. Priest.
Spermatophores of *Loligo*	Mr. J. Slade.

Section of *Anamista cocculus* ...	Mr. F. H. Ward.
„ „ *Rhipsalis cassytha* (double stained)	
Transverse Section of *Aristolochia sipho* (double stained)	
Stellate Hairs of *Correa*	Mr. T. C. White.

Attendance—Members, 82; Visitors, 12.

February 28th, 1879.—Ordinary Meeting.*

Henry Lee, Esq., F.L.S., Vice-President, *in the Chair.*

The minutes of the preceding meeting were read and confirmed.

The following gentlemen were balloted for, and duly elected members of the Club:—Mr. John Bear, Mr. Edward H. Debenham, Mr. H. Epps, Dr. C. T. Hudson, Mr. James H. Mann, Mr. James Menzies, Mr. Henry Nesbitt, and Mr. W. Venables.

Four gentlemen were proposed for membership.

The Chairman said that it was his painful duty to announce the death, since their last meeting, of a former President of the Society, Mr. Peter Le Neve Foster. He had died in harness, and quite unexpectedly; he left his work as usual, went home, and then, being seized by a fatal illness, he passed away. He was 70 years of age, and had therefore reached the "three score years and ten" allotted to man; but time passed so rapidly, and so juvenile was he in his manner, that few would have regarded him as being so far advanced in life. To many of those present he was well known, and to all such it would be unnecessary to say that he would continue to live in their kindly remembrance and respect.

Mr. T. C. White rose to suggest that it would be consistent with the character of the Club to pass a vote of condolence with the family of Mr. Foster in connection with his lamented decease.

The Chairman said it would be most perfectly in accordance with his own views, and he felt sure that the suggestion would be fully approved by the Society.

Mr. T. C. White then formally moved a vote of condolence to Mrs. Foster and family, which, having been seconded by Mr. A. D. Michael, was put to the meeting, and carried unanimously.

The following list of donations to the Club was announced:—

"Proceedings of the Royal Society"	from the Society.
"Journal of the Royal Microscopical Society"...	„ „ „
"Proceedings of the Belgian Microscopical Society"	„ „ „
"Proceedings of the Chester Society of Natural Science"	„ „ „

* Held in the Mathematical Theatre, University College.

Paper by Mr. Kitton, "On Diatoms," reprinted from "Journal R. M. S." ...	from the Author.
"American Quarterly Journal of Microscopy"...	in Exchange.
"Science Gossip"	from the Publisher.
"Journal of Anatomy and Physiology" ...	„ „ „
Pakenham Edgworth's Work on Pollen ...	„ Mr. Bywater.
"Meteorology of Croydon"	„ Croydon Mic. Club.
"American Journal of Microscopy" ...	in Exchange.
"American Naturalist"	„
"Annals of Natural History"	by Purchase.

The thanks of the Club were unanimously voted to the donors.

The Chairman then called upon Dr. Hudson to favour them with his explanation of the subject of the illumination of Rotifers on a dark field. (An abstract of this communication will be found at p. 164.)

The Chairman expressed his regret that their President had not been able to be with them on that occasion, for no one who had not made a complete study of these organisms could do complete justice to the subject. Dr. Hudson was one of their best authorities on Rotifers, and was, at the same time, one of the clearest demonstrators he had ever had the pleasure of listening to, while his method of illustration could only be characterised as accurately beautiful and altogether superb. He had the greatest pleasure in proposing a vote of thanks to Dr. Hudson for his very admirable lecture, and for his kindness in coming all the way from Bristol to deliver it, and to show them his very beautiful diagrams.

The vote of thanks having been put to the meeting and carried by acclamation,

The Chairman called upon Dr. Matthews to give an explanation of the Micro-Megascope, a new method of showing microscopic objects, irrespective of size. (See p. 167.)

A vote of thanks to Dr. Matthews was unanimously passed, the Chairman observing that he was sure they would welcome anything which added to the enjoyment of the microscope, even if only in a toy form.

Mr. J. D. Hardy thought that, in the interests of the Club, he ought to mention that Mr. Jas. Smith had, he believed, exhibited an identical arrangement, or certainly one very much like it. He had shown it at his (the speaker's) house, and also at the Hackney Microscopical Society, but he did not claim it at all as his original idea, but, on the contrary, he said he got it from some American paper. He certainly was enabled to show transparent objects as well as opaque ones, and was able to diminish them, and also to magnify them up to a half-inch objective. It was just possible that Dr. Matthews might have hit upon some improvement upon it, and he only regretted that Mr. Smith was not present to speak for himself. He thought, however, that for the credit of the Club he ought to mention that the idea was not a new one.

The Chairman said that it was quite right and necessary in the interests of science that priority of discovery should be frankly

challenged and properly established. It was possible, as the last speaker had said, that Dr. Matthews might have accidentally hit upon an idea that had occurred to some one else, but it was impossible to suppose for an instant that Dr. Matthews would bring before them as his own discovery, and describe to them the process of deductive reasoning by which he perfected that discovery, knowing that his invention had been practised and published by another. Before Dr. Matthews offered an explanation, he was certain that either this would prove to be one of those cases of simultaneous discovery which sometimes occurred, or that the two processes were not identical.

Mr. Frank Crisp said he thought the only rule they could follow was that of the botanists—that no claim to priority could be recognised unless upon the ground of publication.

Mr. Hardy explained that he had no intention of making the slightest imputation in the matter; he only thought it would not be quite the thing for this idea to be claimed as something new, originating from the Club, whereas it had already been published in an American paper.

Dr. Matthews said that when he was first informed that Mr. Smith had brought out something of the kind, he wrote to him on the subject. Mr. Smith kindly called upon him, and then described the method he had adopted, and made the same disclaimer as to the originality of his idea.

Mr. Ingpen remembered that Mr. James Smith certainly said that Dr. Matthews' use of the principle was different from his own, the original idea of which he had taken from some American publication. The *principle* had, of course, been known ever since the microscope had been in use; it was, in fact, that of the terrestrial telescope; the aërial micrometer, and the erecting glass also more or less involved the same idea. He had recently heard that Mr. James Smith had some time since exhibited opaque objects in this manner, and he wished that he had known of it at the time, because he would then have given it all the publicity in his power. So far as the remarks of Mr. Hardy were concerned, he did not think that any invidiousness was intended, and he felt sure that if Mr. Jas. Smith had been present he would have been the first to acknowledge any merit on the part of what Dr. Matthews had devised, and to thank him for bringing it before the Club.

Notices for the ensuing month were then given out, and the meeting adjourned to the Library for the usual conversazione, at which the following objects were exhibited :—

Organs of Mouth of Sand Wasp (*Ammophila sabulosa*), retaining natural form and colour of the various parts	Mr. F. Enock.
Photograph to illustrate the principle of the Micro-Megascope	Dr. Matthews.
Grains of Aleurone in Bean of Castor Oil Plant...	Mr. F. H. Ward.

Attendance—Members, 115; visitors, 32.

Conversazione.

The Conversazione of the Club was, by the kind permission of the Council of University College, held on Friday, the 14th of March, and was attended by about 1,050 persons. This number was smaller than was anticipated, the reduction being probably due to the unfavourable weather, and to the Conversazione being held in Lent.

One hundred and fifteen microscopes were brought by members of the Club; seventy by members of the South London, the Croydon, the Sydenham, the Greenwich, the New Cross, the Tower Hill, and the Hackney Societies. The bays of the library were also, as on previous occasions, filled with the best productions of the leading London opticians.

In addition to the display of microscopes were the following attractive features:—

A Natural History Lecture, entitled "Curious Houses and Queer Tenants," delivered by Mr. W. R. May, in the Mathematical Theatre.

An exhibition, by Mr. A. C. Cole, of a large number of physiological and pathological specimens by means of one of Mr. Browning's "Lantern Microscopes," kindly lent by him for the occasion.

An exhibition by Mr. G. J. Smith (for Messrs. How and Co.) of the oxy-hydrogen Kaleidoscope, experiments with polarized light, photographic transparencies, &c.

A number of scientific diagrams were kindly lent by Messrs. Hardwicke and Bogue, and were shown in the Museum.

A selection of operatic and other music was performed in the Flaxman Hall by a very effective band, under the leadership of Mr. R. W. Barratt.

The following is a list of the objects exhibited by our members and those of the various Societies above-mentioned, so far as could be ascertained from the table-tickets:—

Tree-bug (*Tingis crassicornis*)	Mr. T. G. Ackland.
Spicules of *Cucumaria pentactes*	Mr. Wm. Adams.
Sheep Tick	Mr. W. Addis.
Section of Carrot (not mounted) ...	Mr. W. Adkins.
„ „ Human Hair, polarised ...	
Snake-head Coralline, *in situ*	Mr. C. Allison.
Eye of Lace-wing Fly	Mr. G. Alstone.
Crystals from Wine (Claret)... ...	Mr. F. W. Andrew.
Section of Pear, showing Raphides ...	
Sand from the Salt Lake, Utah	Mr. A. Arch.
Lung of Kitten; Sections of Human Scalp, Tongue and Kidney	Mr. A. Ashbridge.
Wing-case of Beetle	Mr. H. A. Auld.
Mosquito; Spiracles of *Acilius sulcatus*, &c. ...	Mr. J. Badcock, Jun.
Grouped Polycistina; Young of *Anodon cygneus*; Raphides in skin of onion	Mr. E. S. Balchin.
Volvox globator; *Stentor*, in fission, &c. ...	Mr. A. H. Barker.

Fungus on Fly; Peacock Copper Ore ...	Mr. J. A. Batchelor.
Saw of Saw-fly; Section of Screw Pine ...	Mr. J. Berney.
Coneatus tamarissi; Skin of Dog Fish ...	Mr. W. A. Bevington.
Tick of Cobra, India; Leaf of *Deutzia*, &c. ...	Mr. R. G. Bishop.
Pollen of Orange Lily	Mr. W. Bishop.
Melicerta ringens; *Vorticella*	Mr. J. W. Brigstock.
Section of Tail of Puppy, injected	Mr. W. J. Brown.
Spines of Star fish, arranged	Mr. G. Browne.
Transverse Section of stem of Pepper ...	Mr. E. R. Budden.
Anther and Pollen of *Lavatera rubra* ...	Mr. M. Burgess.
Stephanoceros; *Spongilla fluviatilis*	Mr. A. Butt.
Rotifers	Mr. J. W. Cafe.
Section of Labrador Spar, polarised	Mr. G. Carr.
Section of Whalebone; Section of Granite ...	Mr. J. A. Clark.
Sheep Tick	Mr. Joseph Clark.
Head of Crane Fly; Parasite of Beetle (*Gamasus coleoptratorum*) ...	Mr. H. H. Coel.
Spores of a rare British Fungus (*Tetraploa aristata*); Parasitic Leaf-Fungus (*Microsphæra pulchra*)	Dr. M. C. Cooke.
Pollen of *Acacia dealbata* (?)	Mr. A. C. Conhead.
Cristatella mucedo; *Volvox globator*; *Conochilus volvox*; *Lophopus cristallinus*	Mr. W. G. Cocks.
Scales of Butterflies arranged as a Bouquet ...	Mr. F. Coles.
Grouped *Polycistina*; Spicules of *Gorgonia*; Stem of *Clematis*, double-stained	Mr. G. T. Collingwood.
Shell of *Haliotis splendens*; *Ceramium acanthionatum*, &c.	Mr. A. L. Corbett.
Feathers of Humming Birds	Mr. T. Crossfield, Jun.
Moth's Wing	Mr. J. H. Crossland.
Calcareous Bodies from Shells of *Echinus* ...	Mr. R. E. Crossland.
Transverse Section of *Sarsaparilla*; Mid-rib of India rubber Plant, double stained	Mr. E. A. Crowley.
Transverse Sections of *Dracæna* and *Clematis*, double-stained	Mr. P. Crowley.
Palate of Limpet	Mr. T. Curties.
Larva of *Ephemera*	Mr. E. Dadswell.
Arachnoidiscus, in situ; *Isthmia nervosa* ...	Mr. G. G. Daniel.
Wing of *Urania*; *Ichneumon*, &c.	Mr. G. Dannatt.
Feathers of Humming Birds	Mr. T. W. Dannatt.
Thorax of Diamond Beetle	Mr. W. Dannatt.
Platino-cyanide of Magnesium; Echinus spine; Section of Pearl ...	Mr. T. D'Aubeny.
Sections of Teeth	Mr. A. Dean.
Polycistina, grouped; Section of Jaw of Mole, polarised	Mr. H. H. Dobson.

Drosera rotundifolia, &c.	Mr. T. R. Duggan.
Chrysaora of *Hydra tuba*; Eggs of parasite of Peacock	Mr. C. G. Dunning.
Group of *Vorticella*; *Plumatella repens* ...	Mr. F. East.
Surirella gemma, *Pleurosigma angulatum*, in Balsam, shown with Zeiss' 1-12 inch oil-immersion objective and Abbe's condenser	Dr. Edmunds.
Transverse Section of *Aristolochia sipho*, double-stained	Mr. C. Emery.
Sections of Hypersthene, Green Avanturine, and Egyptian Agate, polarised ...	Mr. H. A. Erlebach.
Philodina roseola	Mr. T. D. Ersser.
Campanularia gelatinosa; Fructification of Fern	Rev. H. J. Fase.
Balanus balanoides (alive)	Mr. F. Fitch.
Jaw of Spider; Spicules of *Synapta vittata* ...	Mr. J. Flower.
Internal Silicious casts of *Foraminifera*; Tongue and Lancets of African *Tabanus*	Mr. H. E. Freeman.
Hydra viridis; *Daphnia pulex*	Mr. G. Gardiner.
Sugar Mites	Mr. F. W. Gay.
Scalariform Vessels in stem of Fern; Section of stem of Sarsaparilla... ...	Mr. E. George.
Frond of *Polystichum angulare*; Leaf of *Citrus anrantium*	Mr. W. H. Gilburt.
Section of Laurel Leaf, stained; Pollen of Evening Primrose; *Protococcus nivalis*	Mr. H. G. Glasspoole.
Parasite of Flying Fox (*Nycteribia*)	Mr. J. W. Goodinge.
Wood Spider	Mr. C. H. Goodman.
Tooth of Saw-fish; Jaw of Cat; Bone of Tortoise, &c.	Mr. W. Goodwin.
Transverse Section of Mahogany, polarised ...	Mr. H. R. Gregory.
Gizzard of Cricket; Mignonette; Antennæ of Emperor Moth...	Mr. W. Gregory.
Foraminifera	Mr. H. F. Hailes.
Globigerina Ooze (2,000 fathoms); Indian Diatoms; Spicules of Sponge ...	Mr. E. Hardy.
Carchesium; Gills of Mussel	Mr. J. D. Hardy.
Chlorate of Potash; Platino-cyanide of Magnesium	Mr. F. Harrisson.
Chloride of Cadmium; Platino-cyanide of Magnesium; Nitre, &c.	Mr. H. T. J. Hart.
Proventriculus of Starling	Mr. R. Headley.
Bicellaria ciliata; *Danæa alata*; Teeth of *Acanthurus*; *Echium violaceum* ...	Mr. F. W. Hembry.
Fern leaf, double stained	Mr. F. H. P. Hind.
Hairs of Sea Mouse	Mr. G. Hind.

Spores of Fern	Mr. C. W. Hovenden.
Arranged Butterfly Scales; Section of Human Kidney	Mr. W. S. How.
Cyclosis in *Vallisneria;* Platino-cyanide of Magnesium; Section of Lower Jaw of Mole	Mr. D. Howard.
Skin of back of Horse	Mr. W. H. B. Hunt.
Diatoms from the Wandle, Stour and Mole; Foraminifera, &c., from Sponge ...	Mr. W. Ingrams.
Section of Human Muscle, Injected; Colorado Beetle; Palate of Snail ...	Mr. F. Inskipp.
Young Salmon (three weeks old)	Mr. S. Israel.
Hypnum rutabulum	Mr. E. Jaques.
Platycerium alcicorne; Sections of Chalcedony and Sun-Stone, &c.	Mr. F. C. Kellow.
Section of Brake (*Pteris aquilina*) ...	Dr. R. C. Kibbler.
„ „ Grape Vine Stem ...	
Spines and Plates of Brittle Star; Section of Rattan Cane	Mr. E. Kiddle.
Polycistina; Section of Bamboo	Mr. F. J. Kitsell.
Sections of Teeth of Leopard and Ass; Seeds of *Nemesia versicolor*, &c.; Whole Spiders, &c.	Mr. J. R. Leifchild.
Eggs of Parasite of Pheasant; Eggs of *Polyommatus alexis*	Mr. C. Le Pelley.
Alpine Insects; Iridescent Scales on body of Moth; *Batrisus formicarius* ...	Mr. R. T. Lewis.
Pollen of Garden Mallow; *Cholesterin* polar ...	Mr. T. M. Loftus.
Fermentation of Malt Liquor and formation of Yeast; Cuticle of Geranium ...	Mr. H. Long.
Feather of Sugar Creeper	Mr. F. McKenzie.
Sections of teeth of Hake and Pike; Scale of Pike	Mr. J. B. Magor.
Larva of Lobster; Head of Silk-worm Moth ...	Mr. H. K. Marriott.
Crystals of Silver; Section of Laurel Leaf ...	Mr. A. Martinelli.
Objects shown by the "Micro-megascope" ...	Dr. Matthews.
Crystals of Common Salt and Nitre	Mr. J. Menzies.
Mucous Membrane of Diphtheria	Mr. G. A. Messenger.
Tegeocranus latus, Nymph and Mature form; *Gamasus crassipes; Verruca stromia*, an Acorn Barnacle	Mr. A. D. Michael.
"What's his Name?"	Mr. A. Milledge.
Sections of Stems of *Modecca tamifolia* and *Argyria multiflora*	Mr. H. Morland.
Parasite of Ox; Wing of *Phalauna* Butterfly ...	Mr. T. S. Morten.
Sections of toe and nose of White Mouse, Colon of Cat; HumanMolar tooth; Tongue of Puppy	Mr. W. J. Nation.

Sea Cucumber, from Torquay	Mr. Jas. Nelson.
Section of head of Wasp	Mr. E. T. Newton.
Stephanoceros Eichornii	Mr. J. Offord.
Polyzoa from the Crag	Mr. C. P. Ogilvie.
Head of Crane Fly	Mr. J. C. Oswald.
Copper; Scale of Adder, polarised	Mr. S. Overton.
Foot of *Dytiscus*; Tongue of Blow-fly ...	Mr. H. R. Owen.
Vorticella; *Conochilus volvox*	Mr. F. Oxley.
Proboscis of Blow-fly; Wing of Burnet Moth ...	Mr. S. Palmer.
Spinnerets of Spider; Young Salmon... ...	Mr. C. N. Peal.
Electra verticillata; Leaf of *Rhododendron calaphytium*	Mr. H. W. Peal.
Larva of Gnat; *Cyclops quadricornus*; Mites in Cheese	Mr. G. Pearce.
Larva of Ephemera	Mr. A. C. Pearcy.
Arranged Butterfly Scales; Platino-cyanide of Barium; Lower Jaw of Mole; Section of Lamprey	Mr. R. A. Potts.
Photographs	Mr. T. H. Powell.
Hydroid Zoophytes (living)	Mr. B. W. Priest.
Diamond Beetle; Spicules of *Synapta*; Leaf Insect; Pond life	Mr. T. Purdue.
Gizzard of Flea; arranged Diatoms; Parasite of Flying Fox	Mr. G. E. Quick.
Stomach of Frog; Antheridia of *Nitella*; *Metzgeria furcata* in fruit ...	Mr. J. W. Reed.
Leg of *Cyphus germari*; Diatoms from Penang	Mr. F. Reeve
Batrachospermum moniliforme and *B. atrum*, mounted in spirit in 1866; Diatoms *in situ*	Mr. W. W. Reeves.
Microphone by Blakey's patent Battery; a rare Fossil Fish in Amber	Dr. Reilly.
Section of Stem of Water Lily	Mr. T. Rogers.
Arranged Diatoms...	Mr. H. J. Roper.
Mouth of Beetle; Frog-hopper	Mr. J. Rowlett.
Cyclosis in *Nitella*; *Stephanoceros*	Mr. Jas. Russell.
Parasite of Cat (*Tricodectes*)	Mr. Jos. Russell.
Section of Schorlaceous Granite; Collection of Crustacea	Mr. T. D. Russell.
Titanic Sand from New Zealand; Section of Echinus Spine; Brecciated Jasper; Atlantic Soundings	Mr. S. B. Saffery.
Carchesium polypinum	Mr. W. L. Sergeant.
Diatoms; Hairs on leaf of *Dentzia scabra* ...	Mr. E. Scargill, Jun.
Section of Lung of Smothered Child; Human Lung in health	Mr. W. L. Scarr.

Trichina spiralis, in Man, Pork, and brain of Rat	Mr. W. J. Scofield.
Coneatus tamarissi; arranged Butterfly Scales	Mr. R. Sedgwick.
Pond life—*Hydra viridis*; Larva of May-fly ...	Mr. H. L. Sequeira.
Entomological Specimens; Eggs of Parasites of Mallee Bird and Reeves Pheasant; Eggs of Chalk Hill Blue Butterfly and House-fly, &c., &c.	Mr. J. S. Sequeira.
Spiniferous tubercles of Lingthorn; *Cladonia pyxidata*	Mr. W. Short.
Sections of Seed Vessel of *Antirrhinum majus*...	Mr. J. C. Sigsworth.
Pollen of Mallow; Wing of Peacock Butterfly; Polycistina	Mr. J. J. Simmons.
Circulation of blood in tail of Newt; Larva of *Ephemera*; Living *Entomostraca*	Mr. E. Simpson.
Hydatina senta; Leaf stalk of *Ficus elastica*; Oxalate of Potash and Chromium, &c.	Mr. T. Simpson.
Hydra viridis; Spicules of *Gorgonia*, &c. ...	Mr. W. Smart.
Blossom of Hazel; Fossil plant-sections in Coal	Mr. Alpheus Smith.
Leaf of *Deutzia scabra*; *Echium glabrum* ...	Mr. Jas. Smith.
Lepisma; *Podura*; Larva of Centipede (alive)...	Mr. J. A. Smith.
Stem of Japan rush, stained; Larva of Tiger Moth...	Mr. R. A. Smith.
Palate of Whelk, polarised	Mr. W. L. Smith.
Ballia callitrica, an Australian seaweed ...	Mr. W. S. Smith.
Hydra fusca	Mr. J. H. Stanley.
Animal and Vegetable Parasites of the human skin and hair	Mr. Jas. Startin.
English Moths—preserved Larvæ and life-histories	Mr. F. Stewart.
Plumatella hatching from Statoblasts; *Corethra*	Mr. D. J. Stuart.
Pond Life	Mr. E. B. Sturge.
Oil glands of Lavender; *Granictis ceterach* ...	Mr. E. D. Suter.
Aulacodiscus Margaritaceus (10 rays) ...	Mr. K. J. Tarrant.
Micro-rulings on glass and steel; simple form of Aquarium Microscope ...	Mr. Washington Teasdale.
Section of Eye of Drone-fly; Salivary glands of Cockroach	Mr. T. Terry.
Jaws of Cockroach; Tongue of Bee; Wing of *Morpho cypris*...	Mr. J. Thompson.
Daphnia pulex; *Stephanoceros Eichornii* ...	Mr. W. A. Tinney.
Root of Lime; English Diamond Beetle; Elm Moth	Mr. W. Trickett.
Shells from Turkey Sponge, &c., &c.	Mr. A. Topping.
Pond Life (*Cyclops*, &c.)	Mr. W. C. Vernon.

Selected Diatoms	Mr. J. W. Walker.
Sponge; Illustrations of the Structure of *Dysidea fragilis*	Mr. J. G. Waller.
Section of human scalp and small intestine; *Trichina spiralis*, &c., &c. ...	Mr. W. Walters.
Cheese Mites; Foraminifera from Post-Glacial Sands	Mr. S. Warburton.
Section showing the Junction of Mistletoe and Apple-stem (double stained)...	Mr. F. H. Ward.
Section of *Equisetum* (double stained); Pupa of *Stylops* emerging from abdomen of Wild Bee	Mr. A. Warner.
Wing of Plume Moth; Spiracle of *Dytiscus marginalis*	Mr. H. R. Warrington.
Head and Leg of Spider; Proboscis and Antennæ of Drone-fly	Mr. F. L. Waterman.
Arranged Diatoms	Captain Weatherley.
Wrangelia multifida; Lomentaria articulata (Marine Algæ)...	Mr. W. West.
Campanularia (Marine Zoophyte); Stem of *Clematis vitalba*; Young Trout ...	Mr. T. Charters White.
Capsules of *Funaria*; Spines of Star fish ...	Mr. G. Willcocks.
Arranged Diatoms; Crystals of Manganese ...	Mr. J. R. Williams.
Transverse section of Bamboo Cane, polarised	Mr. C. Willmott.
Thistle Gall-fly (*Trypeta cardui*); Three spined Stickleback, polarised ...	Mr. F. Wood.

Amongst the large number of professional exhibits, the following claim special notice:—

Mr. Bailey—Students' Microscopes; Improved Portable Folding Microscopes; a Series of Rock and Mineral Sections, &c.

Mr. Baker—"New Model," and Binocular Microscopes, &c.

Messrs. R. and J. Beck—Improved large-sized Portable Microscope, with rotary stage and Iris diaphragm; "Economic" Microscope; "Popular" Microscope, &c.

Mr. Browning—Microscopes with Stephenson's Binocular Arrangement; New Miniature Microscope; Micro-Spectroscopes, &c.

Mr. Crouch—New "Histologist's" Microscope, with special 1-2, 1-5, 1-6, and 1-10 inch objectives; "Alpha" School and Botanical Microscopes, &c.

Mr Enock—Insects mounted without pressure, showing their internal structure undistorted.

Messrs. Horne and Thornthwaite—Portable Equatorial Reflecting Telescope; Polarising Kaleidoscope; Ackland's Dioptric Optometer, &c.

Messrs. Hunter and Sands—A Collection of Histological and Pathological specimens shown under several microscopes.

Messrs. How and Co.—Microscopes showing a series of specimens illustrating Roch-structure; New Miniature Microscope Lamp.

Mr. G. H. King—Freshwater Aquaria with Gold-fish; Microscopical Aquaria with *Daphnia*, *Hydra*, *Diatomaceæ*, &c.

Mr. Moginie—Travelling Microscopes, and Portable Lamps; Colorado Beetles; Arranged Groups of Insect-scales; Ancient Glass from Cyprus, &c., &c.

Messrs. Murray and Heath—Students' Microscopes, Binocular and Monocular; Pocket Seaside Microscope. In the Museum—Revolving Album; Praxinoscope; Cabinet Stereoscopes, Graphoscopes, &c.

Messrs. Pickard and Curry—A Series of Preparations, illustrating the Histology of the Human Eye.

Messrs. Powell and Lealand—Cyclosis in *Vallisneria*, with 1-16th Immersion Objective and Patent Binocular; Podura Scale, with 1-8th Objective; *Volvox globator*.

Messrs. Ross and Co.—New Ross-Zentmeyer Microscopes; Various other forms of Microscope; Case with complete set of Apparatus.

Mr. Swift—"Challenge" Microscope, with patent spiral rack motion for coarse adjustment; Travelling Portable Microscope; New Camera Lucida, &c.

Messrs. Watson and Son—"Standard" Binocular Microscope; Large Binocular and Small Medical Microscopes, &c.

Ordinary Meeting.—March 28th, 1879.

Dr. J. Matthews, F.R.M.S., Vice-President, *in the Chair*.

The minutes of the preceding meeting were read and confirmed.

The following gentlemen were balloted for, and duly elected members of the Club:—Mr. F. E. Bird, Mr. Francis Hallowes, Mr. C. E. Hawkins, and Mr. David Smith.

Six gentlemen were proposed for election.

The following Donations to the Club were announced:—

"Proceedings of the Royal Society"...	from the Society.
"Proceedings of the Botanical Society of Edinburgh"	„ „
"Proceedings of the Geologists' Association" ...	„ Association.
"The Midland Naturalist"	in exchange.
"The Analyst"	from the Editor.
"Proceedings of the Belgian Microscopical Society"	„ Society.
"Science Gossip"	„ Publisher.
"The American Journal of Microscopy" ...	... in exchange.
"The Annals of Natural History"	... by purchase.
12 Slides of Stained Vegetable Tissues ...	... from Mr. F. H. Ward.
1 Slide of "*Glyciphagus plumiger*"... ...	... „ Mr. A.D. Michael.
4 Slides of Richmond and Pittsburgh Deposits	„ Mr. Peticolas. (per Mr. A. Allen).

The thanks of the Club were unanimously voted to the donors.

The Secretary read the report of The Soirée Committee.

Dr. M. C. Cooke read a paper "On the Dual Lichen Hypothesis."

The Chairman said he had no need to invite their attention to the very admirable paper which they had just heard, feeling sure that it had already commended itself to them. There were so many points of interest in it that he hardly knew which to refer to; but it had struck him that Dr. Cooke's remarks as to the selective power of insects did not bear very strongly upon the argument, because it might be said of them that "what was one man's meat was another man's poison."

Dr. Cooke thought that the Chairman had not quite understood his reference to insects—what he meant to say was that if these two classes of plants were identical, why did not the same insects attack both of them? If these insects attacked all fungi, then why did they not attack the lichens also, if it were a fact that the lichens were of precisely the same nature?

Mr. Charles Stewart said he felt it somewhat presumptuous on his part to speak at all upon this subject after what they had heard from Dr Cooke, but inasmuch as he had the honour of first bringing this theory before the notice of the Club, he thought that perhaps he might be permitted to make just one or two remarks. In the first place he would submit it as being an open question as to whether a specialist was really the person most likely to take a fair view of what ran counter to his own ideas? Secondly, it seemed to him that there had been two contradictory statements made upon the subject. It had been said that from the *Hyphæ* were developed the *Gonidia*, and if this were shown to be the case, it would go very far to overthrow the hypothesis. But there was also another statement, that the spores developed in the *Asci* of a lichen, although they would germinate would not continue to grow, but would form merely an abortive attempt at germination without the assistance of certain green granules to which attention had been already called. The theory was that this was a case of dual existence, and he must say that it was a theory naturally suggestive to a scientific mind. If any one looked at the *Asci* of the Lichens, and looked also at the *Gonidia*, although there might not be an absolute identity, yet there was, he thought, a very close resemblance between the former and the *Asci* of Fungi, and between the latter and Algæ; and it should not be forgotten that it had been said that any one of the *Gonidia* could be caused to go through the life history of the Alga, from which it was supposed to have been derived. For his own part he thought it was at present a balanced question, and one which whilst it was as yet unsettled, was one not to be settled by big words.

Dr. Braithwaite said he had been very much struck by the theory of Schwendener when first it came under his notice; he read it carefully and with very great interest, but yet somehow it never seemed to bring with it a conviction of its correctness. Most things brought a kind of conviction with them, but somehow to his mind this did not. One thing especially seemed unsatisfactory, and that was, how should these lichens maintain their habits and characters if their existence was explained by this theory.

Dr. Cooke had treated the subject so exhaustively that he felt bound to admit that whatever balance of opinion he might have had on the other side had been transferred after hearing this very able paper.

Mr. Frank Crisp wished to enter a mild and friendly protest against the way in which Dr. Cooke had spoken of such men as Stahl and Schwendener. They were men of great respect in their own country, and he thought it was hardly well for it to go forth that they had been referred to slightingly by any one connected with the Quekett Club.

Mr. A. D. Michael said there was just one little point to which he should like to call attention, and that was that he thought the definition given of parasitism was rather liable to lead to error. If they were to take it that the parasite lived necessarily at the expense of the organism upon which it was parasitic, then some other term must be found for those which were always found in connection, and which did not live at the expense of each other. Almost every bird had *Dermaleichi* upon it, and if we were to trust the authority of the best observers *Dermaleichus* is not injurious to the bird; but also living on the bird was found a *Cheyletus*, which devoured the *Dermaleichus*. Here, then, were two distinct classes of creatures living upon the same organism without being in any way injurious to it. If these were not parasitic they must find some other name for those which lived on others without drawing their sustenance from them.

Dr. M. C. Cooke said he had very little to say in reply to the observations which had been made, and indeed he thought very little was necessary. He thought that Mr. Michael had made a man of straw and then knocked him down, probably not having clearly understood his meaning. Certainly *Dermanyssus* was a parasite, but parasites were not necessarily injurious to the creatures on which they lived. His remarks, however, referred to the parasitism of fungi only—to which he believed his observations correctly applied. He thought that his friend Crisp had made a slight mistake—he did not call Stahl any names, because he knew him to be a learned professor, who had done much good work in his time; therefore he had nothing disrespectful to say of Stahl. He pleaded somewhat guilty, however, of using rather epithetical terms of Schwendener. He knew nothing of Schwendener, neither did anybody else, except that he had borrowed an idea from De Bary, and then got a little cheap popularity out of it. As regarded the remarks of Mr. Stewart, he must say that they were put forward in such a way as to leave no room for any one to complain, the gentlemanly manner in which he could bring anything forward was so well known, and the manner in which he had got up to reply to what was a deadly attack upon his position was worthy of all praise. As to the question itself, he did submit that there was a good deal in it which might seem attractive, and there was also something in what had been said as to Specialists; but, on the other hand, he thought it must be conceded that they had an amount of experience which others had not. He would venture to say that after having had an experience of twenty-five years in the study of fungi, he was in a better position to form an opinion on some points than

those who were without it; yet every day he fancied he knew less, whilst every year he gained in experience. As to the *Hyphæ* producing the *Gonidia*—twenty-eight years ago the Rev. J. M. Berkeley published his opinion upon the subject—Tulasne stated that he had seen *Gonidia* produced at the ends of the *Hyphæ;* Thwaites examined a good many of these things, and came to the same conclusion; and their observations were also confirmed by Müller.

The Chairman said that the subject suggested one practical piece of advice, which was that some of the members of the Club should take up the subject and work it out for themselves.

A vote of thanks to Dr. Cooke was then proposed by the Chairman, and carried by acclamation.

Excursions and meetings for the ensuing month were then announced, and the proceedings terminated with the usual conversazione, at which the following objects were exhibited:—

Transverse Section of Leaf, through stomata ...	Mr. F. W. Andrew.
Spine of *Echinus attratus*	Mr. A. L. Corbett.
Gall Fly (*Trypeta cardui*) retaining natural form and colour	Mr. F. Enock.
Section of Lower Jaw of Cat	Mr. J. J. Hunter.
Stentor	Mr. F. C. Kellow.
Euglena viridis	Mr. A. Martinelli.
Oribata lapidaria, showing the extension of the chitinous dorsal surface of the abdomen distended so as to form a flexible wing-like process on each side, which can be folded down over the legs so as to protect them entirely ...	Mr. A. D. Michael.
Pleurosigma angulatum, shown with an Oil Immersion $\frac{1}{8}$ objective	Mr. T. H. Powell.
Æcidium depauperaus—scattered violet cluster-cups	Mr. H. J. Roper.
Gamasus coleoptratorum—parasitic on Beetles...	Mr. T. C. White.

Attendance—Members, 83; Visitors, 7.

An Easy and Simple Method of Resolving the Finest-Lined Dry Diatomaceous Tests, mounted on Cover, with special Reference to *Amphipleura pellucida*.

By Adolf Schulze.

(*Read April* 25th, 1879.)

The object of this article is to call attention to an excellent method of resolving the finest-lined tests, mounted dry and on cover. This mode of illumination I discovered in the course of my attempts at resolution, but I doubt whether I have been the first to employ it, as it is really so very simple that others can not have failed to discover it too, but as I read and hear continually of the great difficulties in "checking" *Frustulia saxonica*, and in "lining" *Amphipleura pellucida* even with the best objectives I cannot but assume that the method is not generally known, hence my reason for describing it.

When I succeeded in resolving *Amphipleura pellucida* in balsam, by means of the Reflex Illuminator, I became aware of the great value of immersion condensers as a means for the utilisation of the full apertures of immersion lenses, but I saw at the same time that *substage* immersion condensers would only be of value for objects mounted in balsam or for objects mounted dry on the slip, whilst for objects mounted dry on the cover they were practically valueless, because rays of the requisite obliquity, emanating from the substage immersion condenser, have so great obliquity that they are totally reflected internally from the upper surface of the slip, and so never pass through the layer of air to the object. It was, therefore, clear that immersion condensers for the oblique illumination of objects mounted dry on cover could not be substage, but must be *superstage* ones, *i.e.*, condensers joined to the upper surface of the cover to which the diatom or other object adheres. The *immersion objective itself* presented the first claim as a superstage immersion condenser, and the oblique illumination was readily obtained by the interpolation of

a so-called *vertical or opaque illuminator* between the nosepiece and the objective.

The vertical, or opaque illuminator, was originally constructed for viewing uncovered opaque objects with dry front objectives, and it consists simply of a short tube, having a small circular aperture in its side, and a reflector moveable on a horizontal axis inside this tube. On its simplest form, in the patent opaque illuminator of Messrs. R. and J. Beck, the reflector consists simply of a thin circle of covering glass. Messrs. Powell and Lealand use a plate of parallel glass, and Professor Hamilton L. Smith, of Hobart College, U.S., the inventor of this apparatus, uses a small silver speculum, placed on one side of its horizontal axis, whilst in another form there is a small rectangular prism covering half of the aperture. Messrs. Powell and Lealand add a small diaphragm with four circular apertures of various sizes, of which the smallest appears to me to be the most useful, as the larger ones produce too much glare.

The *modus operandi* is the following: Place the tube of the microscope perpendicularly, or nearly so, screw the vertical illuminator between the nosepiece and the immersion objective, so that the aperture through which the light is to fall stands in front. Then place the lamp, the narrow side of the wick turned towards the microscope, right in front of the latter, at a distance of from six to ten inches. After having roughly focussed the lens on the side, adjust the lamp in a vertical direction, so that a line perpendicular to the optical axis of the microscope, drawn through the centre of the aperture of the vertical illuminator, passes through the lowest point of the flame, or just over the top of the wick. Adjust now the reflecting surface of the vertical illuminator on its horizontal axis, so that a distinct image of the flame appears in the field of vision. This image will, of course, appear brightest, and the definition best, when the narrowest side of the flame is turned towards the instrument, which can be easily ascertained by turning the oil vessel of the lamp a little round its axis, whilst looking into the microscope. The field is now quite dark, and nothing is seen but a streak of light about a quarter of an inch in breadth, which passes through the middle of it antroposteriorly. If all this has been carefully attended to, and if a diatom, adhering closely to the cover, is moved in this image of the flame, its markings will appear most beautifully and distinctly resolved, provided that they are lying *across* the path of light. Various little advantages may be gained by a more careful

regulation of the relative heights of the light to that of the aperture of the illuminator, or by shutting off one half of the aperture of the latter, or by allowing the light to fall only on the lower half of the aperture, etc., all of which have for their object to let the light fall on only one half of the reflecting surface, leaving the other for the passage of the rays from the object to the eyepiece. The image of the flame does not always intersect the whole of the field, and in this case it falls more in the forepart of the same. The Dallinger lamp gives a high flame, and consequently a very long intense image dividing the field into two halves, whilst the motions of this lamp ensure a speedy and accurate adjustment. Carl Zeiss's water immersion lenses, especially the 1-8th; Powell and Lealand's fine new formula water-immersion, 1-8th, and those magnificent oil-immersion lenses*, the 1-8th, 1-12th, and the 1-18th of the former maker, are those I have tried in this way, and with all of these I have succeeded in obtaining resolutions of the finest-lined diatoms in a way not to be obtained by achromatic condensers, prisms, lenses, &c., by transmitted lamplight.

Amphipleura pellucida resolved in this manner shows its outlines with the greatest distinctness and without appearing in the least degree distorted. The ribs are clearly defined, and the mid-rib reveals a fine black line running along its middle, whilst the cross-striæ appear black and beautifully separated, extending over the whole floor of the valve on both sides of the mid-rib, and between the marginal rib, and between the latter and the broad ends of the former. This diatom assumes an olive or light green hue, according to the objective used. Under a power of 400 diams. the markings on the smallest specimen become distinctly visible, and with sufficient amplification they may easily be counted by the flame of an ordinary paraffin lamp, having a wick one half-inch broad. Beautifully as these cross-lines are resolved, I cannot see any longitudinal lines, not even with the 1-18th oil-lens. I am of opinion that many who honestly believe that they can well resolve *Amphipleura pellucida* will readily grant, after having seen the resolution of this diatom with the vertical illuminator, that they have been labouring under a delusion, and that they have only well succeeded on abnormally marked valves.

Frustulia saxonica, *Navicula crassinervia*, or *Navicula rhomboides*,

* On Stephenson's system.

are easily lined or checked, according to whether their mid-ribs are lying in the direction of the image of the flame, or at an angle of about 45° to the latter. Even on damp slides of *Stauroneis spicula* (of which there seem to exist more than of good ones), the cross-lines on this diatom may be readily and distinctly seen.

Surirella gemma assumes an olive-green colour on that part which is in close contact with the covering glass, and shows rows of exquisite, small, and regular hemispherical beads, but by no means hexagonal markings.

Navicula cuspidata assumes a beautiful iridescence, and shows its elongated beads to perfection, and is altogether a lovely object

Pleurosigma angulatum shows its markings as regular, small, and widely-separated beads. Take any diatom you like, and the result on that part with which it adheres to the cover is equally satisfactory and often surprising. It is easily seen whether an object adheres to the cover or not, as in the latter case its outlines appear ill-defined, and the whole as in a haze.

I sum up the *advantages of the mode of illumination here described* under the following heads :—

1. The *correctness* with which objects and their details are seen.

2. The *ease* with which the most difficult resolutions are obtained, as the veriest tyro in microscopical illumination may, with a suitable objective, resolve the most difficult diatomaceous tests known, in a few minutes time.

3. The *simplicity and cheapness of the apparatus* employed, the vertical illuminator being obtainable at so low a cost as about twelve shillings.

4. The *adaptability of the illluminating apparatus employed to the simplest stands.*

5. The value of this method as *a means* of expeditiously *testing objectives* with regard to the utmost limits of their resolving power, and under the most favourable illumination, because the illuminating ray impinges on the object at just that greatest angle at which the objective is capable of receiving, or of transmitting the same.

On a Method of Examining the Anatomy of *Actinia mesembryanthemum*, with some Results.

By Francis Alfred Bedwell, M.A., F.R.M.S.

(*Read April* 25, 1879.)

Plates XI., XII.

Part I.

The extraordinary difficulties surrounding a practical study of the anatomy of the *Actinidæ* can only be appreciated by those who have encountered them. No treatise gives us any account of a dissecting operation. Mr. Gosse* mentions his success in treating *Tealia crassicornis* with laudanum ; while Frey and Leuckart†, after admitting that for a long time they were quite baffled, add that they found this same species in Heligoland in great quantities in an enfeebled state, and that thus only were they enabled to make out what they record. Mr. Teale‡, in his paper on the subject, shows such an intimate acquaintance with individual parts that he must have possessed some excellent contrivances for dealing with specimens, but, unfortunately, he mentions none.

The method which I am about to describe can only be applied to *A. mesembryanthemum*. It is as follows : Take a specimen of the *Actinia* in the left hand ; place the thumb on the centre of the base and the second finger on the oral aperture; turn the base uppermost, and, with a fine pair of curved scissors, make round the thumb a circular cut in the base concentric with its margin, and about the size of a sixpence. This circular cut alone will not free the insular piece, and the scissors must be quickly inserted on the under side of it, and a few snips given close to its under surface and made in a plane parallel to that of the base itself. The piece will now come away, and there will be left, supported by the second finger of the

* Gosse, "Actinologia Brit." Introduction, p. 15.
† Frey and Leuckart, "Worhellosen Thiern" (1847), p. 1.
‡ Teale, "Leeds Phil. Trans.," Vol. I. (1834), p. 91.

left hand, an annulus, in the centre of which will be a confused heap of convoluted band (craspedum). This, with its so-called mesentery, must be cut away freely, but carefully, and when this is done the *septa* will be disclosed. They must be kept washed with a little very weak solution of acid and water, to stay the accumulation of mucus, and in as much as the muscular contraction of the parts does not, as a rule, set in for three or four minutes, it will be found, if the specimen is kept on the finger, it can be examined in detail, with the help of a watchmaker's glass in the eye, and a camel's hair brush held in the hand to turn over the septa.

The details of the different portions of the interior organization have, with one exception to be presently noticed, been so frequently figured on a gradually extending scale by Spix* (1809), Teale (1834), Wagner† (1835), Frey and Leuckart (1847), Cobbold‡ (1853), and Gosse (1860), that it would be wholly unnecessary for me to allude further to the subject, but for the fact that, owing no doubt to the great difficulties of dissection, the account and list of the organs is still incomplete, and also, that notwithstanding all the labour spent upon the subject, there really does not, so far as I know, exist a complete diagrammatic picture in perspective of the interior organisation of the animal. The drawings of Spix, Wagner, Sharpey§, and Rymer Jones‖ for instance are all, I should say, on too small a scale, and also attempt too much, while those of Teale, of Frey and Leuckart (adopted by Professor Huxley in his work on Invertebrates), and an admirable one in Mr. Lewes's "Seaside Studies" (adopted in Green's "Cœlenterata") are perfect as far as they go, but are, in fact, taken from special varieties, and, moreover, they do not pretend to give the general scheme of the interior.

Fig. 1, plate XI, is an attempt to supply this deficiency. To try to represent in a diagram, organs or eggs *in situ*, would tend to confuse, and would likewise be injudicious, for while the diagram here given,¶ so far as it goes, is correct as a representative skeleton, for all the *Actinidæ* on which I could verify it, namely, *Actinia*

* "Annales du Museum," xiii., 1809, plate 33. These plates are repeated in Knight's "Animated Nature."

† Weizmann's "Archives," 1835, Vol. I., pl. 2, pps. 215-219.

‡ "Annals Nat. Hist.," 2nd Ser., Vol. II., 1853, p. 121.

§ "Cyclopædia Anat. et Phys.," I., p. 614 (1835-6). Article on "Cilia." This is the well-known diagram copied into so many modern books.

‖ "Animal Kingdom," 1841, p. 41.

¶ I have only seen the circular openings from septum to septum in *A. dianthus* and *Anthea cereus*.

mesembryanthemum, *Anthea cereus*, *Tealia crassicornis*, *Sagartia parasitica*, and *Actinoloba dianthus*, with a slight variation in the case of *T. crassicornis* (see note post), it would be wrong for some of them if we added the eggs and the organs, for the simple reason that these are carried in different situations in different species.

To explain the diagram it is hardly necessary to remind the reader that as a rule and with a slight exception* one sextant in an *Actinia* answers for all, each *Actinia* being but an aggregate of similar compartments, usually six in number—*T. crassicornis* having a preference for ten, while a few run to four and eight. Fig. 2, pl. XI, exhibits the grouping of the compartments in sextants, and is an exact picture of the base of *A. mesembryanthemum*.

Now to construct a diagrammatic figure we must take one of the sextants of the base, a^1 to a^2, and build up (see Figure) upon it a complete compartment, with disc and stomach-wall to close it in, and then, by suitable incisions, divide the disc and stomach-wall each into two parts, draw the parts aside, and sever them where necessary from the septa that carry them. We shall thus disclose to view seven pairs of intermediate septa, but in order to allow of these being drawn in perspective, we must go a step further and separate the large pair of primary septa a^1, a^2, which form the boundaries of the sextant, and by turning these septa, as if on a hinge, away from the parts which we seek to exhibit, and allowing them to take with them the pieces of the disc and stomach-wall which we have excised, we produce the result seen in the diagram, Fig. 1. It must be borne in mind that the disc rests upon and is attached to all the septa, while the stomach wall is attached, not to the septa called quaternaries, but only to primaries, secondaries, and tertiaries; these carry the stomach-wall, and by their powerful contractions and expansions give it its elasticity and force as a *compressorium*.†

It is no doubt true that every now and then abnormal cases occur, particularly in *A. dianthus*, in which a few abortive and extra septa that do not reach the disc at all, are found; but I think they are exceptions, and the diagram may be relied on as the normal form.

* This exception refers to the two gonidia carrying compartments, and of these there is one only in *A. dianthus*. See Gosse (l.c.)

† I think it doubtful whether the quaternaries in *T. crassicornis* ought not in fact to be treated as actually reaching the back of the stomach-wall, but if they do reach it, it is by an arch so elevated that it thins off into a very slight rib-like projection running along the under side of the disc and the back of the stomach-wall. See Part II.

There are tentacles appropriate to each pair of septa, but these again could not be represented, as they sit on the disc in a special order, the six primary tentacles being nearest the oral aperture, the six secondaries further back, and so on. The imaginary transverse sections, figures 3 and 4, pl. XI, will assist the reader in understanding the diagrams.

The establishment of a definite standard skeleton, so to speak, in the mind, is most valuable, for when we come to deal with other species, these cannot be opened for inspection like *A mesembryanthemum*, but require to be dealt with in fragments, and by picking up by inspection and dissection here a fact and there a fact, so that it is most important to know "where we are" in each of them when we begin to operate.

Passing now to other *Actiniæ* we shall find that *Anthea* is troublesome to obtain but easy to manage, too delicate and frail to be treated like *A. mesembryanthemum*, but if it is laid in water a quarter of an inch deep it will flatten down until the free edge of the stomach wall round the oral aperture is disclosed; and then with a paint brush the edge of the wall or curtain can be lifted up and the interior examined.

Any attempt to treat *A. dianthus*, *T. crassicornis*, or *S. parasitica*, in the way suggested for *A. mesembryanthemum*, will end in a failure, the mere touch of the steel produces such muscular contraction as to defy investigation and this goes on through the whole process of decay. The line between life and death in fact in an *Actinia* is a very difficult one to establish, and I doubt if the muscular contraction ever absolutely disappears in the presence of sea water unless the parts are entirely disintegrated.

The only method in which *T. crassicornis* can be dealt with so far as I know is to lay it out flat like *Anthea* in a very little water in a saucer. After a day or two the free edge of the stomach wall appears like a veil or curtain as in *Anthea*. A brush can then sometimes be inserted with success under the free edge of the stomach-wall, and the relation of the parts made out by probing under that member. The menstruum used by Mr. Gosse quite failed with me.

With respect to *S. parasitica*, that is a most useful *Actinia*, for the first thing that it does on reaching the tank is to leave the shell on which it is riding, and as it seldom or ever affixes itself to a stone or to the glass, but remains lying on its side in the aquarium, it can be taken out for examination at any time, and replaced when done with. In the next place its disc is extremely transparent, and

always open in water ; and it has this charming habit that if you place it in a wine glass of sea water it at once lifts its disc to the surface, so that by bringing a lamp over it you can throw the light through a bull's-eye into the interior, and make out the relation of the parts ; but, further, it will allow you to do what no other *Actinia*, that I know of, will permit ; for with a sharp pair of scissors you may cut off one of the tentacles, and it will hardly flinch ; if then you quickly insert a piece of jeweller's fine gold wire into the hole thus made, you will find that by help of the light falling on the wire, and by watching the undulations of the septa as the wire moves them, you will be able to follow and distinguish their several edges, while a crochet needle or knitting pin inserted into the oral aperture will reach the gold wire and settle, if you have any doubt of it, an extraordinary question, which seems, strangely enough, to have puzzled some Naturalists, namely, whether the aperture is closed at the lower extremity of the cylinder or not!

A. dianthus in young specimens is very transparent at its sides and base, and as both these last mentioned *Actiniæ* are easily obtained along the coast from Weymouth to Swanage, and travel well, they are most useful to the naturalist.

There is another way of dealing with the two last named species which only requires a quick hand and the arrangement of the various septa, as shown in Fig. 1, to be carefully kept in view. It is to extract through the side of the specimen one of the quaternary septa. In order to find these you have only to look at the base (see Fig. 5, pl. XI), or to trace down the external coat of the specimen the primary septa which correspond with the large front tentacles and with the knee-like projections on the oral aperture and are always easy to see—on either side of this primary pair you will be always sure of finding a quaternary pair d^1, to d^4 in Fig. 1—having found a pair make two rapid longitudinal cuts with a sharp knife, one on each side of the line, where the septum meets the epidermis, but not so as to reach down to the base or up to the disc, and taking care to miss the septum itself. Then with a pair of scissors make two deep transverse cuts perpendicular to the others, and at each end of them, so as to unite the two. This should free the septum if it is a quaternary, and it can then be drawn out with forceps and examined. The dotted lines in Fig. 1, pl. XI. show three of the cuts, the other is hid from sight. Similar incisions may be made in the case of secondary and tertiary septa when found, taking care only to limit

the length of the piece extracted, for owing to their shape only a small portion of them can be drawn out in this way. They can always be found by looking at the base, or by counting from the primary septa a^1, a^2 in Fig. 5, and these last can usually be traced in the epidermis by the extra thickness of their lines of junction. The same plan answers with *T. crassicornis*, only the epidermis must be first scraped off the part to be examined.

Part II.

The above observations led me to one or two very interesting conclusions.

Before I was at all acquainted with the true anatomy of the animal, I was struck with the presence in each of them upon dissection of a remarkable and beautifully plicated or fluted organ, quite distinct from the craspedum, though like it in size, and entangled with it. A specimen taken from *A. mesembryanthemum* was seen to be a lovely green, transversely ribbed or fluted with absolute regularity, ciliated and spotted in two regular lines, with white spots of extreme minuteness. In each different species of the *Actinidæ* I found the organ of a different colour, but in all it preserved the characteristics above described, namely, the flutings and the white spots. It was not, however, until I had discovered the above mentioned method of dealing with *A. mesembryanthemum* that I was able to make out its true attitude as a distinct organ in that animal, and in other varieties. These I will now describe.

In *A. mesembryanthemum* the craspedum grows solely on a projection from the primary secondary and tertiary septa—very rarely, if ever, on the quaternaries. This projection is shown in Fig. 6. pl. XII, where the craspedum and its band has been cut off to show the eggs, which in *A. mesembryanthemum* also lie on this same projection and on each side of it, and *nowhere else* in that *Actinia*. These eggs are of a rose colour, or sometimes a light orange, and the projections on which they appear are seen directly the base is opened, as above directed. Now from this projection upwards towards the disc the edge of the septum in *A. mesembryanthemum* is edged with the fluted organ. Fig. 2, pl. XI, shows the organ as seen under the microscope, attached in places to the septum, and detached from it in others—the septum having contracted down to a false attitude, after being

cut off from the animal. It is seen in its natural attitude in Fig. 5, pl. XI, giving the septum a scolloped wavy appearance. A portion of it is seen again magnified in Fig. 8, pl. XII, where the attitude allows only one row of spots to be seen, and the angle is visible along which it keeps its hold of the edge of the septum. On opening *A. mesembryanthemum*, in the manner suggested above, the delicate fluted edging will be found running along each septum in the attitude pointed out, excepting on the primaries, and even on those occasionally. Through the glass the delicate line of white spots may be seen edging each secondary, tertiary, and quaternary septum, and if each septum is turned over with a brush the corresponding line of white spots on the other side will be visible. A needle will lift the whole of the organ off the septum for inspection, but it leaves the septum more freely the second or third day after the animal has been in the aquarium. It is more strongly developed at some seasons than others. I have seen it best in autumn.

If now we pass to *T. crassicornis*, we shall find that a different relation of the parts under consideration exists, for the eggs grow over the whole surface of the septum. Frey and Leuckart, and Teale confine them in their drawings to a limited mesentery in front of the septum, and filling up the arch where there is one, but I have seen them as in Fig. 9, pl. XII, covering every portion of every septum, even the primaries, and running right up to the craspedum itself, and on to the band to which it is attached; the ova green, pink, and white. The craspedum again is not confined, as in *A. mesembryanthemum*, to a special projection on the primary, secondary, and tertiary septa, but edges them all, quaternaries as well, up to the very disc. On its first appearance it is a single wavy line, as in Fig. 8, pl. XII, like a shirt frill; but subsequently, as the season advances, it bursts out in a series of rich sprays up the edge of the septum, and always exhibits a profuse gathering at the base of the septum, a normal characteristic of all the *Actinidæ*. It was a very long time indeed before I could determine the attitude of the fluted organ in *T. crassicornis*; it was there, I knew, as I had frequently dissected pieces of it out. At length I found it, and at the very back of the stomach-wall, as seen in Fig. 8, where the stomach-wall or curtain is supposed to have been removed. It would seem that in this species the craspedum runs so far up the edge of the septum that it either pushes the fluted organ before it, or does not leave it room to appear in the same position as that in which it is exhibited in *A. mesembryanthemum*, so it passes

forward and begins to appear on the under side of the disc, where the craspedum terminates, and then follows the line of each septum down to the free edge of the stomach-wall. In fact, it was by lifting up that edge that I found it. There is a line of it on the back of the stomach wall answering to each septum, and where the quaternaries occur, it follows a rib-like projection, looking very like a prolongation of a septum along the disc, and down the stomach-wall, and it clings to that rib; but at the angles where the two gonidia lie, it will be found that about a quarter of an inch of the stomach-wall is free and unattached to any septum ; and even there the fluted organ will be found lying at the back of the wall.

In *S. parasitica* and *A. dianthus* its attitude is particularly striking. Here, again, the relation of the parts changes—the eggs take an entirely novel attitude—the craspedum now, as in *A. mesembryanthemum*, never appears on the quaternaries, but only on primries, secondaries, and tertiaries, and at first only at the lower or basal portions of their edges. When the eggs first appear they are seen on the edges of the secondary, tertiary, and quaternary septa, but not on the primary septa, and they lie in separate bunches. Before the eggs appear the upper portion of the edge of each secondary and tertiary, and the whole of the quaternary septum is occupied by the fluted organ, as in *A. mesembryanthemum*, so that when the eggs do appear they actually lift the organ up into the position seen in Fig. 7, pl. XII, a position in which it can be distinguished through the disc of *S. parasitica*, waving backwards and forwards over the bunches of eggs, and at the same time holding on to the septum at each extremity, as in the figure. A magnified group of eggs is seen in Fig. 10, pl. XII. In November, as the autumn advances, the eggs assume in *A. parasitica* a different appearance, and on extracting a quaternary septum it was found that the eggs, which in September were in separate bunches, now lay in four rich continuous longitudinal masses projecting from the edge of the septum, as in Fig. 11, pl. XII ; but still there was no craspedum on the quaternaries. On turning, however, to the secondary and tertiary septa, and extracting portions of them, it was found that there the eggs were not continuous, but the craspedum, which in September was confined to the lower or basal portion of the septum, had ascended it, and appeared in tufts between the bunches of eggs ; and it seems to be due to the fact of its non-appearance on the quaternaries that makes those septa so profusely rich in ova, there

being more room for eggs on them owing to the absence of the craspedum.*

In *Anthea* the position of the fluted organ, and the features distinguishing it from the craspedum, are very obvious, as it is of a brown hue, and throws up the white spots very clearly. I have not examined *Anthea* very often, but my notes show the eggs in November growing, not on the sides, but on the edges of the septa in bunches, and with tufts and sprays of craspedum intervening just as in the case of *S. parasitica*.

In *S. troglodytes* and all other *Actiniæ* that I have met with, the fluted organ is present. In all it is immediately distinguished if viewed as an opaque object, but easily missed as a transparent one. It is but slightly armed with capsules (cnidæ of Gosse) whereas the craspedum is fully armed with them. That it is a distinct organ, and not a mere finish of the septum edge, I think is proved by its position in *T. crassicornis*. In *T. crassicornis*, *S. parasitica* and *A. dianthus*, it differs from *A. mesembryanthemum* in having a keel-like process or ridge all along the back (see Fig. 12, pl. XII).

At first I hoped that it was connected with spermatozoa, but I cannot confirm this view. The white spots on pressure were irresolvable, and under a power of 800 were only reducible to grape-like bunches of small round grains, which, if it was not an optical illusion, allowed a central beam of light to pass through them.

It is an organ which makes its presence recognisable in the living A. *mesembryanthemum* in a very distinct manner, for the disc will be found on external examination to be marked with dots arranged in two circles of 12 and 24 pairs, as in Fig. 13, pl. XII. The dots in the *inner* circle will be seen with a lens to lie, not on, but under the disc, and can be made out to be rows of the white spots of the organ in question, and which appear just at the crowns of the arches of the pairs of *tertiary* septa ; those attached to the *secondary* septa do not show up through the disc, the depth of the arch of that septum being too great to allow of it (see Fig. 14, pl. XII) ; but the tertiary septa being shallow at the arch, bring the spots closer to the disc. The *outer* row of spots is not always present in opaque discs, but when it is present it is due to the same organ making its appearance at the upper end of the edge of the quarternary septa at the points where those septa blend off into the disc.

* This distinction between the November and September aspects of the parts shows the necessity of a continuous monthly series of observations.

In *S. parasitica* the disc will be found also marked with dots, as in Fig. 15, pl. XII. These, however, were not, when I saw them, due to the organ in question, but tc the bunches of eggs which show through the disc, and that is so transparent that all seven pairs of septa in each sextant are represented.

The order of the septa can be well made out through the stomach wall of *T. crassicornis*. The fluted organ is visible through the transparent stomach wall but the white spots are small and faint. When the stomach wall is much extended the quaternaries show the line of white spots through the wall, but the other three septa do not, as their arches being deep carry the line away from the wall.

The characteristic differences between the position of the eggs in *T. crassicornis* on the one hand, and *S. parasitica* and *A. dianthus* on the other, suggests an analogy to the vegetable kingdom, and to those plants which carry their seeds or ovules on the fine edges or sides of parietal placenta, as in the orchis and the poppy.

In conclusion, I would venture to call in question the use of an expression which creeps into several treatises. It is that of " imperfect septa " as applied to the tertiary and the quaternary forms as if they were incomplete. So far as my observations go, they are directly opposed to the idea suggested by those words, and I cannot agree that either of the four pairs of septa which go by repetition to make up the skeleton of the *Actinia*, are open to that appellation, merely because they have not filled up the arches that distinguish them respectively, or because they do not reach the stomach-wall. I venture to think all are quite complete, and if they were otherwise than they are then they would be imperfect, and would at once necessitate some compensating change in the general arrangement of this beautiful product of God's law of creation, whatever that law may be. Obviously one result of the present arrangement is neatness in packing, and considering the pressure sometimes exerted by a contracting specimen this must be an important consideration.

On Some Peculiarities in the Reproductive System of certain of the Acarina.

By A. D. Michael, F.L.S., F.R.M.S.

(*Read April 25th*, 1879.)

Plate XIII.

I have to-night allowed myself to be tempted to occupy a little of your time with matter, the greater part of which is not new. I have, however, thought that the subject is sufficiently curious and interesting to form my excuse, particularly as it is little known in this country, and therefore may probably be fresh to many.

When I commenced studying the *Acarina* I found myself in a difficulty in regard to the reproductive organs. These, from their importance, would naturally be a somewhat primary consideration, and the great variety of position and organization in various families, and the differences of opinion between authors regarding them, call for special remark from any one studying that portion of the *Arachnida*. One difficulty which is manifest to the beginner is how the act of coition is accomplished at all. In some families, as the *Oribatidæ*, *Cheyleti*, &c., the sexual organs are placed in the abdomen, but, in the great majority of cases, the opening is placed on the ventral surface of the cephalothorax and the abdomen being usually large and unjointed it is not apparent how the often very short male organ is brought in contact with the vulva of the female. Apterologists have made various suggestions to explain this difficulty, based, it is to feared, more upon their own ideas of probability, than upon actual observation, while an analogy to the spiders was naturally looked for. It is to the admirable observations of M. C. Robin that we owe what is probably the true solution of what might have continued to be a difficulty, had it not been for certain features of that division of the *Sarcoptidæ*, which we usually call *Dermaleichi*, and which Messrs. Robin and Megnin call "*Sarcoptides plumicoles*," a class of *Acari* entirely parasitic upon birds, but, in the opinion of

these authors, not feeding upon the juices of, or injurious to, the bird, but feeding on the feathers only, or keeping them clean. In these *Acari* the act of coition continues for a long time (as faras has been ascertained probably two or three days), and consequently it is rarely that one examines the feathers of a freshly-killed bird without finding *Dermaleichi* in copulation. There is a species parasitic upon the jay and other birds, said to have been discovered by M. Robin some considerable time ago, why I do not know, as it appears under the same specific name in Kock's work, published long before, which Robin has called "*Proctophylodes glandarinus*," in which the male organ is of extreme length, and the creature is sufficiently transparent to allow it to be plainly seen through the body—this forms a favourable subject for observation. The sexual organs in the *Dermaleichi* are placed in the position above referred to, namely, opening on the sternal surface of the cephalothorax, and usually about centrally between the epimera of the second and third pairs of legs, the male organ being a little further back than the female. The penis is more or less conical, but in some species the cone is short, while in others, like "*glandarinus*," it is lengthened until it assumes the appearance of a spine rather than a cone. The vulva presents much the same external form as in *Glyciphagus*, *Tyroglyphus*, and many other true *Acari*, viz., a longitudinal slit with the labia somewhat separated posteriorly, and protected anteriorly by a strong chitinous horse-shoe shaped band called by Robin a *sternite*, the ends of which are recurved ; this horse-shoe often sends out a straight central projection from its concave side to the anterior termination of the vulva itself, and is frequently supplemented by other smaller chitinous protecting pieces, the entire arrangement forming a very conspicuous feature in the mature female, all signs of external sexual organs being absent in the nymph. It was, however, observed by more than one naturalist, and announced with some hesitation, that what appeared to be copulation took place between the adult male and the female nymph which did not show any external sexual organs, a circumstance not only sufficiently startling in itself but difficult to reconcile with what has been so carefully ascertained by Claparède, and, to a certain extent, by Dugès ; the former of whose observations have been lately confirmed by those of Megnin, viz., that the change from nymph to perfect *Acarus* is not a mere casting of the exo-skeleton, but is an entire dissolution and re-formation of the whole organism, or, as Megnin expresses it, a return to an egg state.

M. Robin watched these creatures, and satisfied himself that copulation did not take place with the adult female, which possesses the conspicuous external vulva with its horse-shoe shaped sternite, but always apparently with the nymph, and it is, I believe, to his investigations that we owe the explanation which appears likely to prove the true one, namely, that although there is only one form of adult male, there are two forms of what must be considered adult females, differing in appearance, and one succeeding the other; and that fecundation takes place in the first stage only and not in the second, while the second form alone lays eggs. The first form, which bears the closest resemblance to the nymph, is called by Robin "*femelle accouplée*," I speak of it in English as the "nubile female." Coition is effected with this nubile female at the anal region, but it was a doubtful question whether there was a pseudo-vulval opening close to the anus or whether fecundation took place by the anus itself. M. Megnin, who has carefully investigated the subject, is of opinion that the latter is the true explanation, the anus being a cloaca, as in birds, &c., and that the vulva is used solely for the deposition of eggs. The second form is called by M. Robin "*femelle fecondée*," a term which I prefer to translate as "reproductive female," as I am not aware that there is any proof that the change does not take place in the absence of actual fecundation. It will be seen that this form in *P. glandarinus* and others is manifestly unsuited for copulation by the anus, that part being protected by strong spikes, which give the creature a singular appearance.

It will naturally be asked what proof exists that the coition is not with the nymph after all, in spite of the apparent improbability. This I understand to be answered by Messrs. Robin and Megnin as follows:—Firstly, that it being improbable, the onus of proof would rather rest upon those who assert that it does exist. Secondly, that although the nubile female is very like the nymph, yet a careful examination will show that it is not identical, but that certain small differences often exist, such as the larger size of the nubile female, and the presence in certain species of two small, cylindrical appendages at the anal end of the body of the nubile female, which do not exist in the nymph, and which are sufficient to show the distinction. Thirdly, that as far as has been ascertained, the female nymph casts its skin as often as the male, without counting the final change to the reproductive female, and that, on this final change, no apparent dissolution and re-formation takes place and that it is only

after the same number of changes of skin as carries the male to perfection that the female enters the nubile stage.

It may be mentioned that, previous to the change to the reproductive stage, the vulva may sometimes be distinctly seen through the nubile skin, and that eggs almost ready for deposition may also be seen in the same manner. I have myself observed apparently fully-formed eggs in what looked like the nymphs of some of the *Oribatidæ*, a fact which renders it most difficult to know which are nymphs and which are not, unless one knows the life-history of the species well.

The result of all this may be shortly stated to be that, whether the form be properly called nymph or nubile female, copulation takes place in most of the *Acarina* in a different stage from egg-bearing and by a different external female organ, and that what is ordinarily called the vulva is an egg-laying organ only, and that the female copulative organ is posterior, and also that the two stages, viz., nubile and reproductive, are often so different that they would not be recognised as being the same creature. It may possibly be worth consideration, whether any instances of suppressed agamogenesis in other animals might be explained by the fecundation of the female in a stage when she does not show apparent external sexual organs.

From MM. Robin and Megnin's works I have given, Fig. 1, a drawing of the posterior part of the male, *P. glandarinus*, showing the penis, *i*. Fig. 2 is the posterior portion of the nubile female with which coition is effected, showing the cylindrical projections *o*. Fig. 3 is the posterior part of the reproductive female, showing the vulva, *l*, and the opaque portion of the sternite, *k*, and even a cursory glance will show the great difference from the nubile form. M. Megnin is of opinion that, in all *Acari*, coition takes place with a female in the nubile stage before the development of an external vulva, and he expressly mentions that this is the case in the genera *Tyroglyphus* and *Glyciphagus*, and this statement is made in the joint paper by Messrs. Robin and Megnin. On the other hand, Robin, in a former paper on *Tyroglyphus siculus*, elaborately describes the copulation of the adult female, and I have myself frequently watched the copulation of *Glyciphagus plumiger*, which has, in every case, taken place with the *adult* female, having an external vulva, but clearly at the anal region of the body, not at the conspicuous vulva with the horse-shoe sternite. I am moreover of

opinion that the penis of the male was inserted, not in the anus of the female, but into the curious conical projection characteristic of the adult females of the genus *Glyciphagus*, which projection is higher in level than the anus. As far as I am aware, no other observer has ever treated this projection as anything except as what Murray calls it "an anal button," although it was known to be tubular, but I cannot help thinking that it is the female copulative organ, and I find that it has a projection or serration of the lower edge which appears fitted to admit and clasp the male one. The ventral aspect of this female projection is like Fig. 6, and its dorsal aspect like Fig. 5, which I have drawn from an allied species, *G. spinipes*, in which the projection is better shown.

The next curious point in the reproductive organs of the *Acarina*, to which I will shortly refer, is the position of the male organ in the *Cheyletidæ*, treating them as a family according to Megnin's view, and including *Myobia*, *Harpirhynchus*, &c., in that family. In all other *Acarina* with which I am acquainted, the penis is either placed on, or emerges through, the ventral surface of the abdomen, or the sternal surface of the cephalothorax. In the *Acari* proper, the male organ is external on the sternal surface of the cephalothorax. In the *Gamasinæ*, *Trombidiinæ*, &c., it is retracted within the body, but emerges in the same position as in the *Acari* proper. In the *Oribatidæ*, *Halicarinæ*, &c., it is retracted, but emerges on the ventral surface of the abdomen, the aperture being closed when not in use by what may be called chitinous folding doors, but in the *Cheyletidæ* the penis emerges on the dorsal or notogastral surface, by an aperture not closed by any door; the position of this aperture varies, in *Cheyletus venustissimus*, *C. parasitivorax*, &c., it is close in front of the terminal anus, in *C. macronycus*, *Myobia musculi*, &c., it is almost in the middle of, or rather further forward, in, the notogaster (*i.e.*, the dorsal surface of the abdomen), and in *Harpirynchus nidulans* it is on the dorsal surface of the cephalothorax. This dorsal position of the penis, which was observed by Claparède in *Myobia musculi*, struck him as something quite unique in nature, but it appears to exist throughout the family, and Professor Semper, of Wurtzbourg, in his treatise upon the "Affinities of the Articulata and Annelida with the Vertebrata," expresses his opinion that the position of organs relatively to the ground has not the importance which Baer attributes to it, and says, amongst other things, that in many Annelids the opening of the

genital organs is either at the side or on the superior surface of the body. Fig. 4 (after Claparède), shows the dorsal aspect of the male *Myobia musculi*, and exhibits the peculiar position of the organ *c*, and its place of emergence, *d*.

The last subject to which I will refer is the nature and structure of the oviduct in the *Oribatidæ*. As far as I am aware, the only author who has noticed this organ (beyond stating the fact of its existence) is Nicolet, who has figured it in *Hermannia piceus* (or, as he calls it, *H. crassipes*), and when I say that it is done by Nicolet it is equivalent to saying that it is done well, but it happens that the organ is shorter and less developed in that species than in most of the family, and, moreover, Nicolet does not describe the minuter structure, which I have found specially interesting, he has indicated it in his figure, but, as indicated it differs slightly from that of the species in which I am about to describe it, and I doubt if it would be understood from Nicolet's figure alone. The species I have selected is *Eremeus oblongus*, one of my reasons for choosing it is the great length of the oviduct, and another the greater transparency of the chitinous exo-skeleton than is usual amongst the *Oribatidæ* which enables the observer to see the organ lying within the body when not extended.

The genital aperture in both sexes of the *Oribatidæ* is usually of a square, elliptical, or truncated conical shape, or some combination of these forms, and is placed, as before stated, in the anterior part of the ventral surface of the abdomen, and is closed by two chitinous folding doors which exactly fit the opening. Within this aperture the oviduct is attached, as shown in Fig. 7, pl. XIII. It is a long, transparent, membranous tube, which, when fully extended, is, in this species, longer than the whole length of the creature, but when not in use it is wholly retracted within the body, and it is the peculiar formation which allows of its being retracted to which I will now refer. In the first place the tube, when withdrawn, appears to be drawn within itself by introversion, but even this is not enough, for not only would it be insufficient in consequence of the great length of the organ, but also in order to allow the very large eggs to pass freely it is necessary that the tube should be capable of expansion laterally as well as in length. When I was examining the organ with a rather low power (I think a half-inch), my attention was called to the mode in which this was effected by a play of iridescent colour. I at once suspected that I was dealing with a lined surface; a higher power

showed that this was so, and that the whole structure was folded into corrugations in both directions, so that it reminded me, more than anything else, of a circular glass ridge and furrow roof, like the transept of the Crystal Palace, only that it would be necessary to fancy the individual panes of each ridge also set ridge and furrow fashion, so that each main ridge would be composed of smaller ridges running at right angles to the main one. It will be readily understood that this structure would easily collapse and expand in both directions without injury. It would, moreover, expand unequally in any direction, and would always retain a certain amount of elasticity.

The oviduct, when excerted, but not extended by an egg, narrows somewhat rapidly from the point of attachment of the chitinous doors, and then continues for the greater part of its length as a tube of tolerably even diameter, deeply and closely corrugated, until it arrives at a sort of slight collar, from which radiates a circle of single hairs ; the tube then narrows to a constriction, which is the narrowest point, and from thence expands sharply to form a bell-shaped termination with the edge cut into wide curved indentations, from within which proceed three long cusps, which remind one of the copulative organs in Diptera. The office of these cusps is to clasp and direct the egg during deposition, each cusp bearing two pairs of strong hairs on its outer surface. It appears to me that the variations in shape and diameter in different parts of the oviduct are chiefly due to the greater or less expansion of the corrugations above-mentioned.

The muscles, by means of which the whole apparatus is excerted have been already well-figured by Nicolet.

PLATE XIII.

Figs. 1 to 3. *Proctophyllodes glandarinus* (× 150) (after Megnin and Robin).

Fig. 1. Male. Posterior part, ventral aspect.

Fig. 2. Nubile female ,, ,, ,,

Fig. 3. Reproductive female ,, ,,

3. 3rd pair of Legs.

4. 4th pair.

a. Epimeron.

b. Coxa.

c. Trochanter.

d. Femur.

e. 4th or shank joint.

f. Tarsus.
g. Tarsal sucker.
h. Copulative suckers
i. Penis.
j. Leaf-like terminal expansions to abdomen of male.
k. Sternite (reproductive female).
l. Vulva.
m. Egg.
n. Anus.
o. Papillæ found in nubile female, but not in nymph.

Fig. 4. *Myobia musculi* (× 170) after Claparède. Male, dorsal aspect.
a. Anterior (scansorial) leg and claw.
b. Mandibles (needle-shaped).
c. Penis.
d. Dorsal elevation and opening where the penis emerges.
e. Anal projection.

Figs. 5 & 6. *Glyciphagus spinipes*. Tubular posterior projection of adult female, highly magnified (drawn from nature).

Fig. 5. Dorsal aspect.
6. Ventral aspect.
a. Edge of abdomen.
b. Central bulb attached to interior dorsal surface of tube.
c. Flap projecting from ventral surface.
The opening of the tube is between *b* and *c*.

Fig. 7. *Eremeus oblongus*, oviduct of female extended, highly magnified (drawn from nature).
a. One of the folding doors which closes the genital opening.
b. Cusps, probably for guiding the egg during deposition.
The ridge and furrow arrangement should be much finer. If drawn on the scale of nature a much larger drawing would have been required to show it.

On Stained Sections of Animal Tissues, and How to Prepare Them.

By J. W. Groves.

(*Read May 23rd*, 1879.)

The staining of tissues by the more simple tingeing agents, as carmine, logwood, and the aniline dyes, &c., is so easy, that it has always been a matter of marvel to me, that of the thousands of slides one sees (I refer now only to those of stained animal preparations), scarcely any are ever stained so as to show the structures to their best advantage; indeed, most of them are utterly useless.

The causes of this failure in producing good and useful stains are several, and in many cases may be due even to the condition of the material when it first comes into our hands; therefore, though this paper is nominally devoted to stains and staining, I shall treat of

1. Material.
2. Methods of preserving and of hardening it.
3. Cutting of the sections.
4. Tingeing agents.
5. Method of staining: and
6. Suggest a few points to which sufficient attention is not generally given in the mounting of the sections, after all the other processes have been satisfactorily completed.

The Material.

This, in all cases, should be as fresh as possible, and I am confident that much of the want of success in staining is due, not so much to inattention to the details of the staining process itself, as to a want of care in having the material quite fresh.

It should always be borne in mind that, though for the knowledge of human histology it is advisable to study it from tissues obtained from the human subject, still it is so difficult to procure these in good condition—to many people even an impossibility—that for general purposes it is far better to utilize similar structures or organs

from the lower animals. Though these may differ in some more or less important details, they do in the main furnish all that for ordinary purposes we require to know of the similar structures in man.

Decomposition rapidly sets in, sufficiently to impair if not to neutralize the subsequent processes ; therefore, except with certain morbid structures which can only be obtained from the post-mortem room, all normal material, and where possible that also which is morbid, should be placed in a preservative fluid, there to be hardened or softened, as the case may be, either directly after the death of the animal or immediately after its removal from the living body.

Preservatives.

These may be divided into two classes—1st, those which simply prevent further alteration, and 2nd, those which, in addition to preserving, at the same time cause hardening, softening, &c., as set forth in the following table :—

- 1. Simple Preservatives
  - Canada Balsam.
  - Glycerine.
  - Goadby's Fluid.
  - Dammar Solution.
  - Glycerine and Carbolic Acid (15·1.)
  - Glycerine Jelly, &c.
- 2. Those which also harden.
  - *a.* Simply
    - Alcohol.
    - Chromic Acid (1-eight per cent. soln.)
    - Bichromate of Potash (2 per cent. soln.)
    - ,, Ammonia (ditto.)
    - Müller's Fluid, &c.
  - *b.* Which colour also.
    - Picric Acid (sat. soln.)
    - Osmic Acid (1-2 p.c. soln.)
    - Gold Chloride (½ p.c. soln.)
    - Alcohol and Carmine, &c.
    - Chromic Acid (1-eighth p.c. soln.) and subsequent immersion in glycerine.
- 3. Those which also soften.
  - For Mineral Salts—Acids.
  - ,, Animal Matters—Alkalis.
- 4. Those which harden some parts and soften others at the same time.
  - Chromic Acid Solution and Nitric Acid.

In the preceding table are enumerated the more ordinary and useful preservatives, each of which will be presently noticed separately ; though, firstly, I wish to draw your attention to three facts in connection with them, which are of the greatest importance, and to the want of a due regard to which may be ascribed a second cause

of failure in procuring good stains, to say nothing of their also being the cause of want of success in cutting thin sections.

These facts are, 1st, that it is necessary to be careful to employ that strength of the hardening or softening fluid which is most suitable for the tissues to be acted upon. What these strengths should be it would be impossible to tell for every case, but I will give those which are most usually employed, and for further details must refer you to that useful work, "Practical Histology," by Mr. E. A. Schäfer.

The second fact is, that small pieces of material and a large bulk of the fluid must always be employed ; say, half a pint of fluid for pieces equal to one cubic inch.

The third fact is, that the fluid (even though that may be alcohol), should be changed frequently. How frequently this change should be made, can only be learned by experience, but for all aqueous solutions it is well to make the first change after a few hours, then every day or two.

Of the hardening agents chromic acid comes first. This should be used in solutions of various strengths, but provided they are frequently changed it is better to err on the side of their being *too weak* than *too strong*, for in the latter case, the tissues become friable, and crumble away before the knife or razor ; besides, it is utterly impossible to stain them properly.

The most useful strengths are $\frac{1}{8}$ or $\frac{1}{4}$ per. cent. aqueous solutions, but before immersing the material in these, it is well to place it in a 2 per cent. solution of bichromate of potash or bichromate of ammonia, for some eight or twelve hours, as they have a greater penetrative power than the simple chromic acid solution, and thus cause the masses to be more evenly hardened. It should be remembered that chromic acid solutions have a tendency to bleach tissues already stained or injected with carmine solutions.

Bichromate of potash and bichromate of ammonia. Either of these may be used in a 2 per cent. solution ; the latter being the more generally useful.*

Alcohol. This is perhaps the most generally useful fluid for those who have not much time to devote to the subject, as with it there is less chance of the material spoiling ; moreover, tissues hardened by its means, give the best results with most of the stain-

* Material hardened by immersion in solutions of chromic acid, bichromate of potash, or bichromate of ammonia, should be removed to alcohol at the end of about ten days, or it will become brittle.

ing fluids. Alcohol should be used rather weak at first, then stronger, till the material is hard enough to cut; except when the freezing microtome is to be employed.

Müller's solution is another most useful hardening agent, especially for the retina and other nerve structures. Material should be kept in it from three to six weeks. Its composition is—

Bichromate of potash,	25 grams.,	or $2\frac{1}{2}$ parts.
Sulphate of sodium,	10 „	1 „
Water,	1,000 c.,	100.

The methods of hardening tissues by drying them is open to many objections, among which may be mentioned the alteration of structures and the difficulty of obtaining thin sections; for, cut them as thin as may be, they will swell when rendered moist again by the subsequent processes.

Softening fluids are usually only required for structures which are naturally hard, due to the impregnation of lime salts, as bone and teeth. For these acids are required, but as it is generally desirable to retain *in situ* the soft parts connected with them, it is advisable to use, as a softener of the inorganic matter, some fluid which will at the same time harden all the soft or organic parts. For this purpose a fluid consisting of

Chromic acid, 1 grm.,
Nitric acid, 2 c.c. (this added last),
Water, 200 c.c.,

is, perhaps, the best. In making it, care should be taken that the chromic acid and water be first mixed, and the nitric acid added subsequently. It is better to immerse specimens containing lime salts in a one-eighth per cent. aqueous solution of chromic acid, or a two per cent. sol. of Pot. Bichrom. for a few days before placing them in this mixture, as by that means the soft parts become more perfectly hardened. A few agents, at the same time that they harden, impart a colour to the tissues, thus, material which has been soaked in chromic acid acquires a green tinge when placed in glycerine, this, though handy for certain purposes, is not generally useful.

Osmic acid, on the other hand, hardens, and, at the same time, imparts a useful *colour*, for it selects all fatty matters and tinges them black. After the material has been partially hardened in a one-tenth to one per cent. aqueous solution of this acid, the process may be completed in alcohol, though if left in acid solution for 12 to 48 hours it will be quite hard enough. When hard it should be

placed in distilled water for a day or two, and the sections should be mounted in a saturated solution of acetate of potash (Schultze).

Gold chloride hardens and stains at the same time, but as its powers of penetration are very small, it is chiefly used as a colouring agent.

Picric acid has considerable properties of hardening tissues, whilst it renders them of a bright primrose yellow, but as it is extremely soluble in both alcohol and water, it wants great care in use if it is desired to retain much of the colour.

Ranvier states that a concentrated solution will produce excellent results in 24 hours ; neither shrinking nor coagulation of the albumen occurring, lime salts being removed at the same time.

Finally one of the hardening agents, capable of furnishing better results than any other, is the freezing method which has fallen into disrepute with some, because they have considered it inapplicable to tissues just removed from the animal. When thus applied they have almost invariably failed, not to obtain thin sections (for these can be cut as thin as may be desired), but to manipulate them when cut, as they tear most readily in every subsequent process, and, when finally mounted, it is found that nought is left but the tattered fragments of what should have been a good preparation.

The freezing method undoubtedly enables us to put up specimens sooner than any other, but before they are frozen they must be exposed for some few hours (say five to 24) to the action of one of the hardening agents already mentioned, so as to partially coagulate the fibrin and albumen, and thus enable the sections to be put through the after processes without injury.

The fresh material should be first placed either in :—

a. An $\frac{1}{8}$ p.c. aqueous solution of chromic acid.
b. A 2 p.c. ,, ,, ,, bichromate of potash.
c. ,, ,, ,, ,, ,, of ammonia, or
d. In alcohol ,, for 8 or 12 hours. It should

then be washed in clean water to remove the hardening agent, when it is ready for freezing.

With this it is necessary to pound the ice into small pieces, and to mix it thoroughly with an equal quantity of salt ; it is moreover necessary to have a free exit for the dissolved mixture.

With material that has been wholly hardened by chromic acid, alcohol, or some other of the re-agents above mentioned, the mass must be embedded in some material for the purpose of supporting

the structures, as well as in some cases of affording a wider surface upon which to rest the razor.

For cutting sections by hand the best embedding materials are :—

1. Olive oil and white wax in equal parts ; or,
2. Cacao butter.

While in machines with hollow cylinders, or for use without any machine, either of those or of elder pith or carrot may be employed.

In cutting sections, by whatever process may be preferred, care should be taken :—

1st. That the razor is in perfect condition, and that its surface be kept thoroughly moist with *water* if the freezing method be adopted, or with *spirit*, when any other mode of hardening is used.

2nd. That *each* section as it is cut be floated into water or spirit, instead of allowing several sections to accumulate on the razor, as they thereby get torn, or otherwise injured.

The next subject we have to consider is that of stains, and how to use them.

The following is a table in which the most useful stains are classified according to their qualities, or method of use :—

A. General stains.			Carmine with excess of Ammonia.
			Eosin (Dreschfeld).
			Molybdate of Ammonia. (This requires the action of light.)
B Selective stains.	Simple. Not requiring the action of light.		Carmine (Beale's).
			Borax Carmine (Golding Bird).
			Logwood (Golding Bird).
			Logwood Acid Soln. (Schäfer).
			Indigo Carmine (Tiersch).
			Anilin Blue (Heidenhain).
			Picric Acid.
	Simple. Requiring the action of light.		Gold Chloride.
			Silver Nitrate.
			Osmic Acid.
			Chloride of Palladium.
	Double.		Molybdate of Ammonia and Carmine.
			Picro Carmine (Schäfer).
			Chloride of Palladium and Carmine.
			Carmine and Indigo Carmine.
			Logwood and Anilin Blue.
			Gold Chloride and Logwood.
			Silver Nitrate and Logwood.
			Silver Nitrate and Gold Chloride.

C. Which will stain in the mass and harden at the same time.
- Osmic Acid.
- Picric Acid.
- Gold Chloride.
- Alcohol + Borax Carmine.
- Alcohol + Golding Bird's Logwood.
- Alcohol + Eosin.

With regard to these, I will give some general rules applicable to most, and then proceed to notice each separately.

In staining, it is a general rule of almost universal application that the fluid should be weak and the quantity large in proportion to the number of sections, or to the mass, as the case may be.

A section which has been in a fluid so weak that 24 or 48 hours, or even more, have been required to produce the requisite depth of colour is almost always better stained than one which has been in fluid which will produce the same tint in a shorter time, for the following reason: that a fluid commences to stain a tissue directly it comes in contact with it. Now from this it follows that the surfaces of the section are stained much sooner, and consequently more deeply than the intervening portions; and if the fluid is strong, this difference will be great.

Again, to produce the best results, the sections should be as thin as possible.

a. Because they take the stain more perfectly.

b. Because the thinner they are the less thickness of coloured structures the light has to penetrate before reaching the lenses of the objective; besides, it enables the deeper structures to be more readily examined with high powers.

Those colours are preferable which are cool and pleasant to the eye—*i.e.*, those which contain least red and yellow.

Provided the staining is perfect, and sufficient to show all the detail of which it is capable, the paler it is the better.

a. Because in the examination with the microscope less light is required, and consequently a continuous protracted observation is less fatiguing to the sight.

b. The eye is not so immediately attracted by points and streaks of bright colour, thereby running the risk of passing over unnoticed details of structure of equal importance, but which do not obtrude themselves before us with the same glaring pertinacity.

Finally, it may be remarked that it is better to use distilled in preference to ordinary water in all processes connected with staining.

With some—as Logwood, Gold Chloride, and Silver Nitrate—this is of the utmost importance.

Those stains which colour all tissues alike are of little use unless employed as a ground to bring out details which would be left untouched by a selective stain, which can afterwards be used, and then their value cannot be over-rated.

Thus Molybdate of Ammonia produces a most delightfully cool blue-grey general stain, which in no way interferes with the subsequent use of carmine, when all the nuclei appear pink on a pleasant neutral tint ground.

To obtain this a five per cent. neutral aqueous solution of the molybdate should be used. The stain is complete in 24 hours, at an ordinary temperature and under the action of light.

Specimens thus coloured become brown by supplementary exposure to the action of tannic acid (1-15) or pyrogallic acid (20 per cent.).

Another general stain is a strongly ammoniacal solution of carmine, but this is of little use, and is best avoided.

Eosin, again, is a general stain, which may be used either before or after the sections have been coloured with logwood. One part of eosin should be used with 1,000 of water.

Many of the other stains, too, which are themselves selective, may be used with others which have a still stronger selective power, and thus for the time appear to be merely general stains. In this way may be used—

Carmine and Logwood,
Carmine and Silver Nitrate,
Logwood and Silver Nitrate,
Logwood and Gold Chloride,

And some others.

Selective Stains.

Of these none is more useful or more pleasant to work with than logwood ; but it is not so commonly used as carmine, because many find it difficult to prepare, and others, from want of success in its use, in consequence, I fancy, of hardening their material in fluids containing chromic acid or bichromates of too great strength.

There are two useful formulæ for the preparation of logwood solutions—

1. Kleinenberg's modified by Golding Bird is easy to use, while

the older it is the better are the results obtained with it. It is prepared thus :—

1. Make Saturated Solutions of Alum, and Calcium Chloride, in proof spirit.

2. Mix in the proportions of eight of the former to one of the latter.

3. Pound a small piece of Ext. Hœmatoxyli (the older the better) ; add to it the mixed solution, and agitate.

4. After two days decant, when it may be used at once, though better after keeping.

A watch glass should be filled with water, and a few drops of this solution added, till the fluid acquires a mauve tint. Into this the sections may be placed, and should remain for 24 hours or more.

The second is Schäfer's Acid Logwood Solution, which is especially useful for certain structures, as tendon cells, &c., which could not be so well shown by neutral or alkaline solutions. It is thus prepared :—

A one per cent. Solution of Acetic Acid is coloured by the addition of 1·3 of its volume of Logwood Solution.

The Anilin Dyes, whether in aqueous or alcoholic solution, gives good results. The best are :—

Roseanilin or Magenta (gr. i. to Alcohol ℥i.), red.
Acetate of Mauvein (grs. iv., Alcohol ℥i., acid Nitric ♏i.), blue.
Anilin Black (gr ij., Water ℥i.), grey-black.
Nicholson's Soluble Blue (gr. $\frac{1}{6}$, Alcohol ℥i., and Nitric ♏ij.), blue.

These, as other stains, should be used weak ; but the chief point to be careful about is, that after the sections are stained they should be passed through alcohol and oil of cloves as rapidly as possible, otherwise the colour will be dissolved out before they reach the balsam.

Heidenhain, in speaking of the use of Anilin Dyes, says :—" The sections, upon removal from alcohol, should remain for a day in a four per cent. neutral aqueous solution, in a moist place, and then be immediately mounted in glycerine and cemented."

Some of the Anilin Dyes are but sparingly soluble in alcohol, whereas they dissolve readily in water. Their colour, as a rule, is increased by acetic acid, but removed by ammonia. There are, however, some exceptions.

The use of benzole for clearing instead of clove oil fixes the colours

better, but has a tendency to produce shrinking in some structures.

The indigo carmine solution, introduced by Tiersch, is a good and useful *blue* stain, especially for sections of brain and spinal cord which have been hardened in chromic acid, and it possesses one very convenient quality—viz., that if the sections are too deeply stained, the excess of colour may be removed by the action of a saturated solution of oxalic acid in alcohol. This reducing process, however, should not be relied on more than is absolutely necessary. It is prepared thus :—

Oxalic Acid, 1 part.
Distilled Water, 22 to 30.
Indigo Carmine, as much as the solution will take up.

Sections should be immersed in this, diluted with alcohol, from 12 to 48 hours, to produce a good colour.

Carmine, first used by Gerlach, is a most useful tinging agent, and if preparations are not coloured too deeply, it is not disagreeable to the eye.

Beale's ammoniacal solution is very good, and so is Golding Bird's borax carmine solution, which possesses considerable powers of penetration, so that small masses (about the size of a pea) may be coloured with it before being sectioned ; and if it is diluted with six times its bulk of alcohol, they may be hardened at the same time, and will be ready for cutting in about 10 days.

Sections stained with the ammoniacal carmine should be washed, and then put into water slightly acidulated with glacial acetic acid (℥ij.—℥i.), so as to fix the carmine.

Beale's fluid is thus prepared :—

Carmine, grs. 10.
Liq. Amm. Fort, ℥ 30.
Glycerine, ℥ 2.
Distilled Water, ℥ 2.
Sp. Vini Rect., ℥ ½.

Dissolve the carmine in ammonia, boil for a few seconds, add the water, filter ; finally add the glycerine and spirit, and keep in a stoppered bottle. Beale says, " Let the excess of ammonia pass off ;" but this is unnecessary, as the excess is very slight.

Beale's stain reduced with eleven times its bulk of water produces good results in from 12 to 48 hours.

The borax carmine is thus prepared :—

1. Carmine, ʒ ½.
2. Borax, ʒ 2.
3. Distilled Water, ℥ 4.

Place 1 and 2 dry in a mortar, and mix; then dissolve in warm water for 24 hours ; after which pour off the supernatant fluid, and the solution is ready for use.

The acid carmine fluid of Schweiggerseidel is also useful in some cases, though Schäfer's acid logwood, already noticed, is preferable.

So far we have had to do only with stains that change but little if at all. Those which we now come to, however, *do* change materially—*i.e.*, get rapidly darker and more opaque, till they reach a stage when they are utterly useless. They differ from all the others, with the exception of molybdate of ammonia, in the fact that the action of light is necessary to produce the colour.

Nitrate of silver, which was introduced by Recklinghausen, is used in a half per cent. aqueous solution. Specimens to be acted upon should be dipped in distilled water to remove any trace of sodium chloride, and then steeped in the silver solution for some two or three minutes, after which they should be washed in ordinary water till it ceases to turn milky ; then placed in glycerine and exposed to the action of light, until they assume a dark brown colour, when they may be mounted in glycerine or glycerine jelly.

By means of this stain the endothelial cells of the lymphatics, blood-vessels, &c., and the nodes of Ranvier in medullated nerves, are rendered evident. They may subsequently be stained with logwood, carmine, or chloride of gold.

Many methods have been adopted for staining with gold chloride. I will mention three—Dr. Klein's, Dr. C. Bastian's, and Mr. Schäfer's.

1. Dr. Klein's method for showing the nerves in the cornea is as follows :—Remove the cornea within 15 minutes of death ; place it in a half per cent. chloride of gold solution for half an hour to a hour and a half or more ; wash in distilled water, and expose to the light for a few days, the water being occasionally changed. Then place in glycerine and distilled water, in the proportion of one to two ; subsequently place it in water and brush gently with a sable pencil to remove any precipitate, when it may be mounted in glycerine. The cornea should now be of a grey violet tint.

Dr. Charlton Bastian's method is at follows :—

Place the sections on portions of tissue, in

Gold chloride ... 1 part.
Distilled water ... 2,000 parts, acidulated with strong hydrochloric acid (drop 1 to water ℥iiß.)

Let them remain protected from light for an hour, then remove and place them in acidulated water, half the strength of the above, and then transfer to a watch glass containing

Formic acid.
Spirits of wine $\overline{aa}$

They should be stained in about half-an-hour.

Or, if it is desired to produce the stain more rapidly, use—

Chloride of palladium ... 1 part.
Water „ ... 500 parts.

Where they should remain five or ten minutes ; then wash in acidulated water, transfer to the formic acid and spirits of wine, as before, and mount.

Mr. Schäfer's method is the use of the double chloride of gold and potassium.

1. Place the fresh tissue in bichromate of ammonia (1-2 per cent. in water) solution for fifteen or twenty days.
2. Dip the sections, after being cut, into—
   a. Water, 1,000 parts.
   b. Double chloride of gold and potassium, 1 part.
3. Wash in—
   Acid hydrochloric ... ... 1-2 parts.
   Water ... ... 3,000 parts.
4. Then immerse for ten minutes in—
   Acid hydrochloric ... ... 1 part.
   60 p.c. solution of alcohol ... 1,000 parts.
5. Transfer to alcohol absolute.
6. Clear with oil of cloves.
7. Mount in balsam or dammar.

In staining with gold chloride or silver nitrate, Mr. Schäfer has found that if the material, after immersion in these stains be dipped into alcohol, the reduction of the metals is thereby greatly facilitated.

Osmic acid, which was first used by Schultze, is useful for the

demonstration of fatty matters, which are thereby coloured black; it is also valuable for some nerve preparations, but it is very irritating to the mucous membranes of the experimenter, and should be used with caution.

Specimens should be allowed to remain in a 1-2 per cent. aqueous solution of the acid from a quarter to twenty-four hours, when the stains will be complete; but if it is desired to harden also by its means, they should remain in it for some few days.

Osmic acid does not penetrate deeply, therefore small portions should be selected for its action.

Chloride of palladium, also introduced by Schultze, is used to stain and harden the retina, crystalline lens, &c., and other tissues, but cornified fat and connective tissues remain uncoloured.

Dissolve :—

Chloride of palladium ...	...	...	1 part.
In water ,,	...	...	1,000 parts.

An ounce of this solution will harden a piece of tissue the size of a bean in two or three days, staining it at the same time a brown or straw colour. Specimens may be mounted in glycerine at once, or may be further stained with carmine.

Before proceeding to the double stains, it will be well to mention Schäfer's silver nitrate and gelatine solution for demonstrating lung epithelium—

Take of gelatine 10 grms.,

soak in cold water, dissolve, and add warm water to 100 c.c.

Dissolve a decigramme of nitrate of silver in a little distilled water, and add to the gelatine solution.

Inject this with a glass syringe into the lung until distension is pretty complete. Leave it to rest in a cool place until the gelatine has set; then cut sections as thin as possible, place them on a slide with glycerine, and expose to light until ready for examination.

Of the double stains I will specially notice only those where the double colour is produced by a single process. Those in which the one colour is first employed, and then the other, I will simply state which is to be used first, as all further particulars have been already given.

Those which are used in a single fluid are—

Picro carmine.
Carmine and Indigo carmine.
Anilin blue and anilin red.

Picro-carmine, which was first employed by Ranvier, has been used and prepared in several ways, but perhaps the best is Schäfer's, viz. :—

1. Add to a saturated solution of Picric Acid in water a strong solution of Carmine in Ammonia to saturation.

2. Evaporate the mixture to one-fifth its bulk over a water bath, allow to cool, filter from deposit and evaporate to dryness, when picro-carmine is left as a crystalline powder of red-ochre colour.

Sections should be stained in a 1 per cent. aqueous solution, requiring ten minutes for a good result ; they should then be washed with distilled water, and mounted in glycerine. If it be desired to preserve them in balsam, after staining, transfer direct to alcohol methylated, then to absolute alcohol, after which they may be cleared in oil of cloves or benzole, and then mounted.

Carmine and indigo carmine adopted by Merbel, gives a blue and a red stain, and is said to be extremely selective.

To prepare the Red Fluid,		For the Blue Fluid	
Take—Carmine . .	℥ß	Take—Indigo carmine . .	ʒij
Borax . . .	ʒii	Borax	ʒij
Water dist. .	℥iv	Water dist. . . .	℥iv

Mix each in a mortar, and allow to stand, then pour off the supernatant fluid.

1. If the sections have been hardened in chromic acid, picric acid, or a bichromate, they should be washed in water till no tinge appears.

2. Place them in alcohol, then

3. For fifteen or twenty minutes, in the two fluids mixed in equal parts, after which

4. Wash them in a saturated aqueous solution of oxalic acid, where they should remain a rather shorter time than in the staining fluids.

5. When sufficiently bleached, wash them in water, to get rid of oxalic acid, then

6. They may be passed through spirit and oil of cloves, and be mounted as usual in balsam.

For Staining Blue and Red by means of Anilin Dyes the best method is that Mr. Gilburt recommends for staining plant sections. Dissolve :—

Magenta crystals	gr ¼ in	} Red.
Alcohol	℥i	

Then Nicholson's soluble pure blue... gr $\frac{1}{6}$ in
Alcohol ... ... ʒi, to which } Blue.
has been added Acid Nit. ... ... mij }

Both solutions should then be filtered.

Use mij of the blue to
mvij of the magenta,

and thoroughly mix.

Place the section in the mixture for about one minute, then remove to absolute alcohol, from that to oil of cloves or benzole, and finally mount in balsam and benzole.

To fix the magenta, it is usually necessary to pass the sections through benzole.

Cements, &c.

For balsam or glycerine jelly mounts, almost any varnish will do but for fluids or glycerine it is necessary to have one that is tough and most likely to prevent leakage ; for this purpose, the following answers very well :—

1. *Mastic and Bismuth.*

Dissolve gum mastic in chloroform, and thicken with nitrate of bismuth.

The solution of mastic should be nearly saturated.

2. *Oxide of Zinc, Dammar, and Drying Oil.*

Rub up :—

Oxide of zinc, well ground, ʒij,
with Drying oil to consistence of thick paint.

Then add an equal part of

Gum Dammar, dissolved in
Benzoline to thickness of syrup.

Strain through close meshed muslin. Keep in well corked bottle, and, if necessary, thin with benzoline.

3. *Mr. Kitton's Cement.*

White lead in powder }
Red ,, ,, } equal parts.
Litharge ,, }

Grind together with a little turpentine, until thoroughly incorporated, and then mix with gold size.

The mixture should be thin enough to use with a brush, and in use one coat should be allowed to dry befor applying another.

The mixture may be kept in a bottle, but no more *cement* should be made (*i.e.*, should be mixed with gold size) than required for immediate use, as it sets quickly and becomes unworkable.

Certain precautions are necessary to be observed in varnishing fluid or glycerine preparations ; they are—

1. Use no more glycerine or fluid than is just necessary to fill up the space beneath the cover.

2. If the medium should escape beyond the cover glass, soak it up with a piece of blotting paper, being careful not to press the cover, or the cement will run in afterwards.

3. Wash the slide round the cover and the edge of the cover glass also if necessary with a sable pencil, then run a ring of cement on the slide just beyond the edge of the cover, a second round the edge of the cover, and a third bridging over the space between the two.

4. Three or four coats should thus be put on, taking care on each occasion that the previous coat is dry.

Of preservative mounting media, the most useful are balsam, glycerine, and glycerine jelly.

Canada balsam should be exposed to heat until it becomes quite brittle, allowed to cool, then it should be dissolved in benzole till as thin as glycerine, and should always be used cold.

Glycerine.—Specimens which have been hardened in chromic acid or bichromates may be mounted in pure glycerine alone, but if they have been hardened in spirit, glycerine and carbolic acid (in the proportion of glycerine 15 parts to carbolic acid 1 part) is better, as it is less refractive and prevents the sections becoming granular.

For carmine stained preparations it is well to add a trace of acetic acid to the glycerine (♏ij : ℥i).

Glycerine jelly is a good medium, as it offers the advantages of glycerine without the chance of leaking, but it is rather difficult to prepare, and therefore had better be bought.

A jelly composed of

Glycerine
Gelatine } equal parts

is very useful ; the glycerine should be warmed, and the gelatine (Nelson's) be allowed to dissolve in it.

Acetate of potash in a saturated solution is used for some preparations, but is liable to leak. The same may be said of Goadby's fluid.

To summarise the whole of this paper :—

1. Let the material be quite fresh.
2. *a.* Take care that the hardening or softening fluid is not too strong.
   b. Use a large bulk of fluid in proportion to the material.
   c. Change the fluid frequently.
   d. If freezing be employed, take care that the specimen is thoroughly frozen.
3. *a.* Always use a sharp razor.
   b. Take it with one diagonal sweep through the material.
   c. Make the sections as thin as possible, and
   d. Remove each one as soon as cut, for if sections accumulate on the knife or razor, they are sure to get torn.
4. *a.* Do not be in a hurry to stain, but
   b. Remember that a weak colouring solution permeates the section better, and produces the best results ; and
   c. That the thinner the section is, the better it will take the stains.
5. *a.* Always use glass slips and covers free from scratches and bubbles, and chemically clean.
   b. Never use any but extra thin circular covers, so that the specimens may be used with high powers.
   c. Always use cold preservatives, except in the case of glycerine jelly, and never use warmth to hasten the drying of balsam or dammar, but run a ring of cement round the cover.
6. Label the specimens correctly, and keep them on the flat and in the dark.

On some Improvements in Microscopical Turn-Tables.

By C. Spencer Rolfe, C.E.

Plate. XIV.

(*Read May 23rd*, 1879.)

About a year or more since, after having my patience somewhat exceptionally tried in using an ordinary Shadbolt's turn-table, I determined to try and devise some better means of securing the slide than the ordinary springs, and permitting it to be removed and replaced without trouble. The result of my efforts I purpose now detailing, in the hope that they may be useful to fellow-mounters of microscopic objects.

Discarding the means usually adopted for centering work in the lathe, as being too complex and difficult of construction for my purpose, I devised the arrangement shown in Fig. I. Two opposite portions of the top are cut away, forming guides, in which the two V-shaped clips slide. These being moved equally from and towards the centre, by a system of levers, (shown dotted, and working on the underside of the turn-table,) which are constantly kept in such a position by an elastic spring, that the clips approach one another.

On the longer of the levers are two knobs, and by pressing either of them round with the finger, the clips open, and a slide being placed between them, and the finger removed, they spring together and firmly hold it, in such a position, that, had the movement been so constructed, the centre would be exactly over the centre of the table. In practice it has been found preferable to have the slide just a trifle out of centre, and by this means it is always possible to replace a ringed slide with the same corners embraced by the same clips, and if this is not done it is at once rendered visible. Were every slide made truly square, this would be unnecessary. A turn-table constructed on this principle was shown to some of the members at the last annual general meeting, and I was then informed by our Hon. Secretary that one for the same purpose had been described

in the "English Mechanic." This, I find, is in Vol. xxi., page 69, but, on reference to it, I find that the designer, Mr. C. F. Cox, of New York, had adopted one of the plans which I had discarded, as I am strongly opposed to holding a material like glass in a rigid grip. Either it is not held securely, or there is great chance of chipping it. At the same time I cannot but state that Mr. Cox's arrangement may possess advantages which mine has not.

The form which I have described entirely satisfied me for a time but I was desirous that the satisfaction I felt should not be confined to myself. I accordingly set about improving away my improvements, and the result has been the turntable shown in Fig. 2, and to this I want more especially to direct your attention, as the arrangement possesses the great advantage of being easily applied to any ordinary turn-table. Moreover the cost of the former one was great, whilst of this, it is but slightly in excess of those at present in use. The figure is a view of the upper side. The top A is by preference made rather larger and heavier than usual, and towards one edge are fixed stops, shown at B B. Opposite to them is a catch C, having a notch in it for the corner of the slide to fit into, the opposite corner at the same time resting against the stops; this catch can be drawn back by the finger, but is constantly drawn towards the centre by a spring D on the underside. By this means the slide is firmly held, not quite centrally, for the reason previously explained, and it can at any time be replaced exactly in the same position. Springs are also provided for holding those slides which have not been ringed on the table, and for exceptional sizes, and which could not be correctly held by the clipping arrangement. The support for the hand has been made to slide back, this being found of great use when dealing with large or deep cells, but in place of the arrangement adopted in the one shown, it would be preferable to have a "dovetailed" slip on the underside of the top of the rest, sliding in corresponding openings cut out of the supports. I think it but just to add that I have never worked with Dr. Matthews' table.

THE PRESIDENT'S ADDRESS.

(Delivered at the Annual General Meeting, July 25th, 1879,)

By Professor Huxley, F.R.S.

In coming before you this evening, I should be glad if you will not consider the few observations which I am about to make, as representing anything so formal or serious as an Address, partly because an Address, in the ordinary sense of the term, is hardly so suited to the character of a Club as something of a more conversational character; and partly from personal reasons,—for it happens that owing to the undoubtedly fresh and open, but rather severe winter through which we are at present passing, I find myself with very little voice this evening, and fear that I shall have still less by the time I conclude.

Since I have held the honourable position of President of the Club, my attendance at your meetings has impressed me very strongly with the great amount of instrumental perfection which is to be observed on those occasions; and I do not think that any one could fail to be struck with the skill displayed in such work, nor could he fail to admire the great patience, the perseverance, the devotion of time and energy displayed by the members of the Club in the pursuit of microscopy.

No doubt one might say that a very large result of this activity is simple amusement; but I happen to be one of those people—perhaps because I get so little of it myself—who think that amusement is an exceedingly good thing; and I am strongly disposed to think the beneficial effects of such amusements as do no harm to a man himself, nor in any way rob his neighbour—especially such as are found in microscopical studies, heightened by the sympathy of those who are associated for the purpose—are very great, and that they are much to be cherished as an important part of the good of human life. So that if it happened that no member pursued the subject for a higher purpose than the gratification of his taste for

the beautiful, or the exercise of manipulative skill, I, for one, should think the time of the Club exceedingly well spent. But happily no one, whatever be his object, who works at the business of the Club, can end in simple amusement. He is dealing with natural objects, and every new thing observed, every fresh beauty discovered, is something added to the stock of natural knowledge ; and every improvement of his instrument makes it a better weapon of scientific research. And not only so, but the habit of mind which creates the possibility of finding amusement in pursuits of this kind, is invaluable as a preparation for the reception of scientific truth, and the cultivation of scientific methods. If I may say so without offence, such amusement may be regarded as an involuntary ploughing and harrowing of the ground, making it receptive of the seeds of science, and preparing it for rich harvests in the future. So, as I said before, whatever member of the Club has joined it for the sake of mere amusement, has done a good thing for himself, and has done probably more than he knows to help those who make these pursuits the serious business of their lives.

But whilst recognising the legitimacy of following out such pursuits for amusement only, I have a sort of feeling in regard to them such as an old recruiting sergeant might be supposed to have whilst looking at a band of rustics sporting on a village green, or at a number of volunteers going through their evolutions. These athletic exercises and this playing at soldiers are all very well in their way ; but the recruiting sergeant with an eye for a man, will see that the sport is training those who have a vocation for the realities of war, and is leaving them to feel their way towards taking part in more serious business. Many of the papers which I have heard in this room have given me the feeling that I should much like to give the shilling, and putting my hand upon the readers, to say " Your proper business is to come into the army of science." And naturally I must feel great gratitude to a society like this, as one of the army of workers who looks at it with an eye to enlistment.

I must, however, separate myself from the recruiting sergeant, because he walks off with his recruit, who is seen no more in the place that once knew him ; while I cannot say positively, that those of you who have a turn for really scientific work may not do better to stop where you are. In fact, you have opportunities which are not possessed by the men who make science a business. The truth

is that the increase of knowledge has its drawbacks, not perhaps as Solomon said—"He that increaseth knowledge increaseth sorrow;" but certainly it is an increase of trouble and an increase of worry. Whoever becomes a man of science by profession must know something pretty thoroughly, and this means that he must not only know pretty accurately this or that piece of detailed work; he must have not only the knowledge of general facts, but must possess the special knowledge also, and be able to guide the one by the other, and to criticise his speculations by his knowledge of detail—this is the only title by which he can sustain his claim. But during the last quarter of a century science has taken to grow in a most portentous and astonishing fashion. I remember the time when it was quite easy for an ordinarily industrious man to keep up with the scientific literature of the period; if he made himself acquainted with what went on here, and if he read a French or German work now and then, it was enough; but, at the present day, to keep up with all that goes on, he must be a most industrious man indeed, and if he even tries to keep up with it he must do an amount of reading which is singularly demoralising to his habits of thought. If he wishes to work out any scientific points with accuracy and detail, it must be a very small matter which does not occupy him for months, and need his closest attention, during which time he will be drifting altogether away from the stream of progress of scientific knowledge. This constitutes the difficulty—*experto crede*—the great difficulty of being broad without being shallow, and of being deep without being narrow. Any one who has exceptional qualities of work or method, may perhaps be able to keep creditably abreast with the course of progress, and to do some work of his own besides; but if he is not so gifted, he has before him one or other of these two unsatisfactory alternatives.

But you, members of this Club, are in this respect vastly better off, because you can give your attention to any one point which you want to get at the bottom of, and you are not likely to be pulled up by some student in the lecture room who has read the latest thing published, and who expresses surprise that you do not know all about it too. Consequently you can give your attention to your own subject as exclusively as you may desire. I do not mean to say that you do not lose anything, for naturally where you have to deal with the deeper problems you will never come to any good unless you have those principles to guide you; but, for three-fourths of the problems of microscopy, although you will require neatness and

skill, clearness of eye, and lightness of hand for cutting and preparing sections, the great amount of general knowledge which a man of science is required to have is of no consequence at all.

Several amongst your number have asked me to indicate those courses of enquiry which may best be commended to members of such a society as this, and it strikes me that the suggestion which I have just made supplies the answer. It is exactly in that field—the following up of details, tracing out minutiæ of structure, in occupying themselves with such questions as are only to be solved by long and patient devotion of time and dexterity, and a thorough knowledge of instrumental manipulation—it is exactly there that men of science find their difficulties, because the amount of time consumed is so great. Take, for example, the application of persistent watching to the unravelment of the life history of a vast number of low organisms ; that is a process which has been adopted in respect to certain fungi in order to ascertain whether they are parasites or variations. In such a case the plan pursued is that of taking the spores and watching them step by step, and there is no other way of doing it ; it involves enormous expenditure of time and great instrumental dexterity, but those who can follow it obtain results which are to be attained in no other way. The work of Mr. Dallinger and Dr. Drysdale, for instance, affords us a very remarkable example of this kind of observation : these two gentlemen mounted guard alternately over a microscope for days and days, watched one identical monad through all its stages ; and they succeeded in tracing out its entire life history, and made an epoch in our knowledge of these lowest forms. Now suppose this kind of observation was to be directed to the *Infusoria* in general, what an opportunity there is for some of you ! Why there is not a single genus or species of which we may say that we know the whole history. The common *Paramecium*, for instance, is one of the commonest things that exists, yet nobody certainly knows whether it has any other mode of reproduction except by fission. The skill which I have seen displayed here is of immense value in such kind of work, and if only applied to it must very soon bring some good results. The like is true also of the *Acinetæ ;* we know something about them, but nothing like a complete history ; and it is a perfect opprobrium to science that nobody knows what an *Amœba* is. I do not mean to say that we do not know the things we call by that name when we see them, but that we are unable to say with certainty what are their modes of reproduction, what are their various states,

which are vegetable and which are animal. Turn to the study of development, the whole of which is in a progressive state. We are now carrying it so far that we can trace back a single group of organs to a particular portion of the dividing yolk mass, and the ultimate result will probably be to trace out each group of organs to the blastomeres from which it has proceeded. Thirty years ago if any one had talked of making sections of a butterfly's or a crayfish's embryo, it would have been regarded as something inconceivable; but now careful section makers will deal with these things in such a way as to be able to make you twenty sections through one of them. But as every one knows, this kind of thing cannot be followed out without a great expenditure of time and an amount of dexterity which it is not given to every one to attain.

Let me also point out that it is not necessary to go far a-field to find subjects for this kind of work; probably what is most wanted is an exhaustive study of some of the commonest things about us. The development of Rotifers, for example; why these are the commonest things in the world. Kowalewsky, years ago, made a number of observations upon the common earth worm; let us see if in his conclusions he was right or wrong. It is not very difficult to make sections of these things, and it would be of great importance to get his observations confirmed. I have no doubt as to their correctness myself, but it would be very satisfactory to have them verified. I might turn to half-a-dozen kinds of similar observations with regard to the development of insects—say the presence of an amnion in some and not in others; any one who could make minute sections would solve the problem for us. It happens that some time ago I occupied myself with a very common subject, by way of carrying out my own precept of trying to get to the bottom of something. I had various reasons for doing this with the common crayfish, and I may say that the result has been very instructive; I mention it to show how much it is worth while to take up common things, if only to find out points about them which have been overlooked. The first thing I did was to examine the branchiæ, and in so doing I found to my surprise that there were two little filaments, about $\frac{1}{20}$ of an inch long, attached to the sides of the body. I had never seen any notice of these things, but I found by-and-bye that Brandt and Ratzeburg had seen them. The curious thing about them was, that these two little filaments occupied the same position as gills, and from this I had little reason to doubt that they were

rudimentary gills, and that there had been gills in that position at some time. I then thought if I could obtain some less modified forms of crayfish, such as are found still in Australia, I should be able to throw some light on the matter. I did so, and found in the place of these rudiments perfectly developed branchiæ. This led me to seek for similarities of structure in the lobster and the marine crayfish, and these again led me on to examine other *Crustacea;* and I need hardly say that the bearing of all this upon the theory of evolution from a common type was very important. From these things I was led to look into the structure of the muscles, the spermatozoa, the chitinous cuticle, the eye, and other parts, and there was not one of these which did not present interesting novelties and would not have taken months of work to get to the bottom of it, so as to make oneself thoroughly acquainted with every detail. You may find plenty of work if even you confine yourselves to such common things as caterpillars. Lyonet, you know, spent many years over his caterpillar, and the result was a monograph which will last for all time.

This is the kind of service which those members of the Club may perform who feel inclined for it; it is work which may be of very great value, and which certainly cannot be undertaken by those who have to occupy themselves with science as a whole.

I think that this is the pith of the remarks which I wished to offer to you this evening, and I find for the reasons already mentioned that I am coming to the end of my tether; but if you will take them as hints and suggestions, they will I am sure receive amplification as you seek to act upon them.

It remains now for me only to do two things—first I have to express my regret for the inefficient manner in which I have performed the not very onerous duties of President of the Club—but I think I may remind you that at the commencement of the term, I ventured to prophecy that such was likely to be the case; the reason, however, has certainly not been the lack of any interest in your proceedings, but simply that I am one of those working men of science whose labours are somewhat manifold; and in the second place, I have to thank you for the kindness and courtesy with which I have been received on this and on all other occasions, and to congratulate you on the election of your next President, who will, I hope, make up to you for all the deficiencies of your present retiring President.

PROCEEDINGS.

April 25th, 1879.—Ordinary Meeting.

T. C. White, Esq., M.R.C.S., &c., Vice-President, *in the Chair.*

The minutes of the preceding meeting were read and confirmed.

The following donations to the Club were announced :—

"Journal of the Royal Microscopical Society"...	from the Society.
"Proceedings of the Belgian Microscopical Society"	" " "
"10th Report of the Liverpool Microscopical Society"	" " "
"Proceedings of the Watford Natural History Society"	" " "
"The Popular Science Review"	" the Publisher.
"Science Gossip"	" " "
"The American Naturalist"	in Exchange.
"The Midland Naturalist"	" "
"Paper on Pollen," by Mr. M. S. Vince" ...	from the Author.
"Quarterly Journal of Microscopical Science" ...	by Purchase.
"Grevillea"...	" "
"Annals of Natural History"	" "
Ray Society's last publication	" Subscription.
Reprint of a paper on the "Modification of Simple and Compound Eyes of Insects," by Mr. B. T. Lowne	from the Author.
Westwood's "Classification of Insects," 2 vols.; Gegenbaur's "Elements of Comparative Anatomy," 1 vol.; Hinck's "British Hydroid Zoophytes," 2 vols.; "Huxley's Anatomy of Vertebrate Animals," 1 vol.; Nicholson's "Manual of Zoology," 1 vol.	By the Dinner Committee of the Q.M.C., the funds having been placed at their disposal by members of the Club.
Two Slides (Lung of Saw-grinder*)	Mr. A. C. Cole.

Photographs for the Club Album, of Mr. Guimaraens and Mr. Jno. Bear.

The thanks of the Club were voted to the donors, and especially to the Dinner Committee for their valuable contribution.

* This lung was removed at a *post mortem* examination of a man *known* to have died from the effects of his work, and supplied the typical specimen upon which the late Dr. J. C. Hall (who sent the lung to Mr. Cole) founded his successful agitation in the columns of the *Times* for ameliorating the condition of the workpeople.

The following gentlemen were balloted for and duly elected members of the Club:—Mr. E. H. Allen, Mr. D. B. Cazaux, Mr. G. F. Chantrell, Mr. Hugh P. Powell, Mr. W. H. Preedy, Dr. H. W. Webster.

Twenty gentlemen were proposed for membership.

A letter was read by the Chairman from the Hon. Secretary of the Royal Microscopical Society, announcing that the President of the Club had been elected an *ex-officio* Fellow of that Society.

It was proposed by the Chairman, and seconded by Mr. Thos. Spencer, that the cordial thanks of the Club be presented to the Royal Microscopical Society for the honour conferred upon them by the election of their President as an *ex-officio* Fellow of that Society. Put and carried unanimously.

The Secretary gave a brief account of the excursions of the Club to Wandsworth, Snaresbrook, and Totteridge, and read a list of objects collected at Snaresbrook, prepared by members of the Excursion Committee.

A paper by Mr. Adolf. Schulze, of Glasgow, "On a Method of Resolving the Finest Lined Diatom Tests," was read by the Secretary, who stated, with reference thereto, that from letters which had passed between the author and Mr. Frank Crisp, it was clear that Mr. Schulze had used this method two years ago, although, in the matter of publication, he had been anticipated by an American observer, and also to some extent by Mr. Stephenson.

Mr. A. D. Michael read a paper "On some Peculiarities in the Reproductive system of some of the Acarina," and illustrated the subject by a drawing on the black-board, and by the exhibition of a number of prepared specimens under microscopes.

The Chairman said he hoped that Mr. Michael's paper would be the means of inducing a great many members to take up a study which afforded so large a field for original observation, and which was, no doubt, intensely interesting. Since seeing Mr. Michael s beautiful slides, he had tried to obtain specimens for himself, but had not been able to find any. Perhaps Mr. Michael would kindly tell them what were the best hunting grounds?

Mr. Michael said that where to look, depended upon what species you wished to find. Some kinds were found almost everywhere, and it would be a more difficult matter to say where they would *not* be found. Others were only found in special positions—*Dermaleichus* was only found on the feathers of birds, others only on mice, others, again, in moss.

The Chairman said he had hunted over large quantities of moss, but was only rewarded by finding one little thing.

Mr. Michael said that he believed the moss-living species were solitary, but this was not the case with many of the others; under the bark of trees they were often found in thousands.

A paper, by Mr. F. A. Bedwell, "On a Successful Method of Examining *Actinia mesembryanthemum*," was read by the Secretary, and was illustrated by drawings and by a coloured diagram.

The Chairman invited remarks upon the paper, observing, at the same

time, that, owing to the lateness of the hour, it would hardly be possible to do justice to a communication upon which so much time and labour had evidently been spent, and which they would not be able fully to appreciate until they had an opportunity of reading it for themselves in the Journal.

On the motion of Dr Matthews, seconded by Mr. Thos. Spencer, the thanks of the meeting were unanimously voted to the authors of the papers.

Notices of excursions and meetings for the ensuing month were then announced, and the proceedings terminated with the usual conversazione, at which the following objects were exhibited:—

Egg of Scarlet Hopper, showing larva	Mr. F. Fitch.
Gammarus, stained	Mr. H. G. Glasspoole.
Euglena viridis	Mr. A. Martinelli.
Myobia musculi	Mr. A. D. Michael (in illustration of his paper).
Glyciphagus spinipes	
Eremeus oblongus (oviduct of)	
Proctophylodes profusus	
„ *glandarimus*	

Attendance—Members, 76; visitors, 6.

May 9th, 1879.—Conversational Meeting.

The following objects were exhibited:—

Section of sucker of Octopus	Mr. F. W. Andrew.
Grass Spider (*Tetragnatha extensa*), showing curious palpal organs, &c.	Mr. F. Enock.
Mould of Salt water damaged, *Cacao Theobroma*, showing bright sulphur-yellow fruit. Mould of Fresh water damaged, *Cacao Theobroma*, showing fruit, Crystalline in appearance...	Mr. H. Epps.
Section of *Bignonia*, Double-Stained	Mr. H. G. Glasspoole.
Section of Bramble, polarized	Mr. W. Goodwin.
Human Ovary, showing ova	Mr. J. J. Hunter.
Stephanoceros	Mr. C. Le Pelley.
Recent Polyzoa (Sp. ?)	Mr. F. C. Kellow.
Camptoptera (Sp. ?) showing a method of mounting and exhibiting minute *Hymenoptera*	Mr. A. D. Michael.
Plumatella repens	Mr. G. D. Roper.
Young *Phalangium*	Mr. T. C. White.

Attendance—Members, 69; Visitors, 0.

May 23rd, 1879.—Ordinary Meeting.

Charles Stewart, Esq., M.R.C.S., &c., Vice-President, *in the Chair.*

The minutes of the preceding meeting were read and confirmed.

The following gentlemen were balloted for and duly elected members of the Club:—Mr. Edward Bonsor, Mr. A. Button, Mr. H. C. Carpenter, Mr. Thos. R. Dallmeyer, Mr. Wm. Dawson, Mr. Wm. F. Dixon, Mr. C. J. Harris, Mr Thos. Isaac, Mr. P. Newcombe, Mr. Wm. J. Pilcher, Mr. J. D. Pritchard, Mr. Wm. Rideout, Dr. Thos. Smith, Mr. Jas. Stocken, Mr. John Stubbins, Mr. C. Sturt, Mr. Isaac C. Thompson, Mr Jno. J. Vezey, the Rev. G. E. Watts, Mr. Jno. Wheldon.

Four gentlemen were proposed for membership

The following donations to the Club were announced:—

"Proceedings of the Royal Society"	from the Society.
"Journal of the Royal Microscopical Society" ...	" "
"Second Annual Report of the East Kent Natural History Society"	" "
"Eighth Annual Report of the South London Natural History Society"	" "
"Second Annual Report of the Hackney Natural History Society"	" "
"The American Quarterly Journal of Microscopy"	in Exchange.
"Science Gossip"	from the Publisher.
"Annals of Natural History"	by Purchase.
"The Midland Naturalist"	in Exchange.
"The Analyst"	from the Publisher.

A photograph for the Club album of Mr. B. D. Jackson.

The thanks of the meeting were voted to the donors.

The Secretary announced that a letter had been received from the Ealing Microscopical Society, thanking those members of the Club who had rendered assistance at the Society's recent Soirée.

Mr. Ingpen offered some observations upon Dr. Matthews' "Micro-megascope." Referring to some remarks that had been made at the meeting of the 28th of February, he said that Dr. Matthews was very desirous of having the circumstances explained, and had requested him to do so in the most explicit manner. They all knew that Dr. Matthews was one of the last men in the world to appropriate without recognition anything that had been done by others. In this case there was no doubt that Mr. James Smith had used a similar arrangement for the same purpose, and that he

had exhibited it at one of the Royal Society's Soirées and elsewhere; and it was to be regretted that he had not written a paper, and so given the matter still greater publicity. Dr. Matthews had communicated with him, and he stated that he got the idea originally from an American source. In any case it was quite clear that Dr. Matthews had worked the matter out independently, and without any knowledge of what had previously been done. There could be no doubt of the great utility of being able to produce very low microscopical powers, combined with fine definition. The old "erecting-glass" fulfilled these conditions very imperfectly, its construction being only suited to the terrestrial telescope; and when used with the microscope, the objective was turned *the wrong way*, giving the *greatest* amount of spherical aberration. In the proper application of the principle, the objective was turned so as to give the most perfect diminished *camera image*, which was magnified by a compound microscope, consisting of the usual eyepiece and an achromatic objective which also acted as an erecting glass. There were two papers by Dr. R. H. Ward, in the "American Naturalist," which were reprinted in the "Monthly Microscopical Journal" for 1872; one "On a New Erecting Arrangement" ("M. M. J.," Vol. vii., p. 11.), and the other "On a New Micro-telescope" (*ib.*, p. 73). In neither of these papers was anything said about *reversing* the object-glass—the all important point; so that many might have tried this plan without success. In Goring and Pritchard's "Micographia," 1837, p. 51, would be found a "Description of a New Micrometer" on this principle. Dr. Goring took care to remark that, in default of a specially-made object-glass, "the *double* object-glass of an engiscope, or two combined, may be used *with the convex lens or lenses turned towards the micrometer*." The micrometer was six inches below the objective, and formed the object, the diminished image of which was thrown on the plane of the object to be measured. Dr. Pigott adopted precisely the same arrangement in his "Aërial Stage Micrometer." ("M. M. J.," 1873, Vol. ix., p. 2). The "Micro-megascope" would be found extremely useful for examining large objects and those situated at a distance, binocularly, for dissecting, and camera lucida drawing, and was, in fact, an all-important addition to the resources of the microscopist. It was easy of application, as all that was necessary was an adapter to carry an objective in the place of the ordinary condenser, thus utilizing any two of the low powers usually supplied. Mr. Ingpen felt sure that the Members would agree with him that even if Dr. Matthews were not the very first to employ the arrangement, they were indebted to him for introducing it, and that they were assured of his good faith in the matter.

Several forms of the instrument were exhibited, including one which Mr. Curties had constructed for application to the Tank Microscope, and kindly presented to the Club.

On the motion of the Chairman, the thanks of the meeting were unanimously voted to Dr. Matthews for his interesting communication, to Mr. Ingpen for his explanatory remarks, and to Mr. Curties for fitting to the Club microscope the adapting mounts.

A paper was read by Mr. C. Spencer Rolfe "On a new microscopical turntable," which he exhibited in the room.

The Chairman, in moving a vote of thanks to Mr. Rolfe, said that the instrument before them seemed to be an extremely ingenious one, and to supply a want which must have been experienced by those who had used the American form of Mr. Cox, which required great care, as too much pressure chipped the slides, or too little rendered them unsteady.

Dr. Matthews said that the special reason why he devised his turntable was to admit of mounting more than one specimen on the same slide, if required. This was often desirable, and with a turntable which permitted of end motion it was very easy. He had also, since then, devised a form of turntable by which any slide which had been drawn eccentrically could be put again upon the turntable to be repaired. He thought that the turntable which had been shown by Mr. Rolfe displayed great ingenuity.

Mr. Michael could not doubt the ingenuity shown in the construction of this new turntable, but he could not help thinking that sometimes they paid a little too much attention to centering, and that a great many very good slides were spoilt by the desire to centre them. When mounting an object it often happened that a slight slip of the covering glass would cause it to get out of the centre, and in attempting to replace it damage was frequently done; and he was quite of opinion that it was better to have the object perfect, though not in the centre, than to have it imperfect and in the centre. The old "Shadbolt" was, after all, equal to the requirements of those who thought that the object should be the centre of the ring, and the most valuable turntable would, he thought, be that which enabled the ring to be made round the object, on whatever portion of the slide it happened to be.

Dr. Matthews said that in the new plan it was possible to have any centre whatever.

Mr. Frank Crisp exhibited a new form of turntable which Mr. Beck had brought from America, and which he thought was very ingenious; the mechanical arrangement connected with the clamps seemed particularly so.

Mr. Ingpen said that the old plan of Mr. Hislop's, of centering by means of a couple of pins, was very good. He had since made the two pins into two screws with flat milled heads and leather washers; a slight pressure from which clipped the slide, whilst allowing of its being easily moved in any way if excentricity was required.

Mr. F. H. P. Hind said he had used the plan which Mr. Ingpen mentioned, and found it a very good one.

Dr. Matthews said he had used this kind also a good deal, in fact he thought he used it more than he did his own.

The thanks of the meeting were voted to Mr. Rolfe for his paper.

Mr. J. W. Groves read a paper "On Stained Sections of Animal Tissues and how to make them."

The Chairman said he need hardly ask them to return thanks to Mr. Groves for his extremely valuable and exhaustive paper upon a subject in which so many of them were doubtless interested, and which he would, without further remark, leave in their hands for discussion.

Mr. T. C. White said that the paper was certainly very exhaustive, and would form a valuable and important addition to the literature of the Club. He should like to ask Mr. Groves if he could give any directions for the use of osmic acid as a preservative fluid for Polyzoa. He had tried it, but found that it acted too powerfully upon them, and caused distortion.

Dr. Matthews said he did not hear any notice of the process of staining by perchloride of iron followed up by pyro-gallic acid, as described by Dr. Hoggan.

Mr. Death wished to ask whether the staining fluids were not divided into two classes, one of which acted by reduction, also whether at any time Mr. Groves had any difficulty with the alcohol. It had been stated that the fresher the subject the better, and in cases where they used fluids with a reducing action, was this true? Did Mr. Groves find that he need not change the fluid so often if he stirred it up?—did not frequent stirring enable the fluid to be used longer?—and in using salts of gold did he use an acid solution? He fully concurred with Mr. White as to the value of the paper.

The Chairman said that he had noticed that glycerine was very frequently suggested as a good medium, also acetate of potash, but he might suggest that their old friend, Canada balsam, was also very useful. With regard to silver stained specimens, he found that they kept their colour exceedingly well, and he had some which had done so for 10 years. In the matter of gold, however, he had generally found that they deepened in colour in a most objectionable way, and he should be glad to know how this could be prevented. Osmic acid did very well also in balsam.

Mr. Groves, in reply, said he had no experience in mounting Polyzoa. He had not tried Dr. Hoggan's process, and knew nothing about it. He had tried stirring up the fluid, and thought it enabled it to be used longer. Salts of gold solution was neutral. He found nitrate of silver specimens keep very well. Osmic acid specimens he had never put up in balsam.

The Chairman gave notice that nominations for Officers and Committee for the ensuing year would be made at the next ordinary meeting. Announcements of excursions and engagements for the ensuing month were then made, including that of the Excursionists' annual dinner for June 19th.

After the meeting the following objects were exhibited:—

Section of Oriental fig, double stained ...	Mr. F. W. Andrew.
Dolichopus trivialis, mounted so as to preserve the iridescence	Mr. T. Curties.
Zygnema quininum, in various stages of conjugation	Mr. H. G. Glasspoole.
Human skin × 170, stained in the mass with borax and carmine	Mr. J. W. Groves.
Tooth of Shark	Mr. J. J. Hunter.
Sertularia cupressina, coated with *Diatomaceæ*	Mr. A. D. Michael.

Parasite of Houbara Buzzard, *Hurbara undulata*	Mr. T. S. Morten.
Medusa from *Coryne minuta*, bred in an aquarium	Mr. T. Charters White.

Attendance—Members, 87 ; Visitors, 11.

June 13th, 1879.—Conversational Meeting.

The following objects were exhibited:—

Spathe of *Anthurium*, with raphides and sphœraphides	Mr. F. W. Andrew.
Amphipleura pellucida, *Surirella gemma* and *Navicula rhomboides*, shown with Homogeneous Immersion Objectives, and the various forms of Vertical Illuminator constructed by Messrs. R. and J. Beck, Messrs. Powell and Lealand, and Herr Zeiss	Mr. T. Curties.
The Praying Mantis (*Mantis religiosa*) showing its characteristic attitude ...	Mr. F. Enock.
Bursa copulatrix of Blow-fly, showing the "two curious lateral folds" of Lowne	Mr. F. Fitch.
Fresh water shells prepared and mounted by Mr. J. F. Cocken	Mr. H. G. Glasspoole.
Aristolochia sipho, double stained	Mr. W. Goodwin.
Kidney of Rat, Injected	Mr. G. J. Jones.
Transverse Section Stem of Misletoe	Mr. C. LePelley.
Gamasus crassipes, Male, showing the great development of the second pair of legs used for holding the female	Mr. A. D. Michael.
Calomel and Corrosive Sublimate, sublimed ...	Mr. H. Morland.
Limnias ceratophylli—branched specimen ...	Mr. J. M. Offord.
Leaf of *Drosera rotundifolia*	Mr. T. C. White.

Professor Abbe, of Jena, who was present as a visitor, exhibited and described the method of using his Illuminator in conjunction with the oil immersion objective, and other apparatus.

Attendance—Members 66 ; Visitors, 9.

June 27th, 1879.—Ordinary Meeting.

Professor T. H. Huxley, F.R.S., President, *in the Chair*.

The minutes of the preceding meeting were read and confirmed.

The following gentlemen were balloted for and duly elected members of the Club:—Mr. Wm. Readaway, Mr. Geo. D. Sawyer, Mr. Jas. Willson, and Mr. Francis Wood.

Eight gentlemen were proposed as Members, and two as Honorary Members of the Club.

The following donations to the Club were announced:—

"Proceedings of the Royal Society" ...	from the Society.
" " Royal Microscopical Society" ...	" "
"Proceedings of the Belgian Microscopical Society"	" "
"The American Naturalist"	in Exchange.
"Science Gossip"	from the Publisher.
"Annals of Natural History"	Purchased.
"Grevillea"	"
"Van Hourck on the Microscope"	from Mr. F. Crisp.
"Parasites and Entozoa," by Dr. Cobbold ...	" Mr. T. C. White.
One Slide	" Mr. H. Morland.
Six Slides of Micro-rulings	" Mr. W. Teasdale.
Six French Natural History Diagrams ...	" Mr. R. T. Lewis.
One Photograph—for the Album	" Mr. J. J. Vezey.

The thanks of the Meeting were voted to the donors.

The Secretary read the following note by Mr. R. T. Lewis, with reference to the diagrams above named:—

"A question in the June number of 'Science Gossip,' as to where tolerably cheap but good plates of birds' eggs, &c., could be obtained, reminded me of a large, and upon the whole, very excellent series of diagrams which had often attracted my attention when in Paris, and to which a passing reference was made in an article which appeared in 'Science Gossip,' in October, 1858. The series in question numbers, according to the latest list, 190 sheets, 22in. × 27in., each containing from 50 to 300 figures, the subjects embracing almost every topic likely to be of interest to the scientific, artistic, or mechanical amateur. Believing that these publications deserve to be better known in England, and that many of them might be at least as useful to others as they have been to myself, I have ventured to bring them under the notice of our members in the most practical of possible ways—namely, by procuring and presenting to the Club a few specimens of the plates themselves. In most instances they may be had either plain or coloured, and in the case of Natural History sheets the names are given in Latin as well as in French. Their size being rather large for an ordinary

portfolio, I have found that by cutting the sheets into six or eight parts and pasting them into a scrap-book, they are made conveniently available for reference when required.

"Any further information I shall, of course, be happy to communicate to those who may be interested in the subject.

"The plates selected by way of samples, and which are laid upon the table for inspection by the Members, are—

	Nos. in Series.
1. Lepidopterous Larvæ	175
2. „ Pupæ	177
3. Butterflies resulting from the same	178
4. Coleoptera	95
5. Zoophytes	153
6. Fungi	78

R. T. Lewis."

The Secretary gave notice, on behalf of the Committee, of a proposed alteration in Rule 2, so as to authorize the appointment of an additional Honorary Secretary, by the substitution of the words "one or more Honorary Secretaries," in the place of "the Honorary Secretary," and a consequent alteration in Rule 3. He also intimated that, in the event of this alteration being sanctioned, Mr. Hailes had expressed his willingness to accept the position of co-Secretary with himself.

The President read the House List of Officers recommended by the Committee for election at the ensuing Annual Meeting, namely—as President, Dr. T. Spencer Cobbold, F.R.S.; as Vice-Presidents, Prof. Huxley, Dr. Matthews, Mr. A. D. Michael and Mr. Charles Stewart; as Treasurer, Mr. F. W. Gay; as Honorary Secretary, Mr. J. E. Ingpen; as Honorary Secretary for Foreign Correspondence, Dr. M. C. Cooke.

Mr. Hainworth was appointed Auditor on behalf of the Committee, and the Members were requested to appoint an Auditor on their behalf.

Dr. M. C. Cooke proposed Mr. Dobson as Auditor; Mr. T. C. White seconded this motion, which was duly carried.

The President then announced that there were seven vacancies to be filled upon the Committee, and requested nominations from the Members.

The following nominations were then made:—

Mr. T. C. White, proposed by Mr. Oxley, seconded by Mr. Gay.

Mr. F. Coles,	„	Dr. Cooke,	„	Mr. Alpheus Smith
Mr. J. C. Sigsworth,	„	Dr. Matthews,	„	Mr. Goodwin.
Mr. Dadswell,	„	Mr. Curties,	„	Mr. F. Crisp.
Mr. J. W. Groves,	„	Mr. Parsons,	„	Mr. Hovenden.
Mr. J. W. Reed,	„	Mr. Newton,	„	Dr. Matthews.
Mr. A. Cottam,	„	Mr. Dobson,	„	Mr. Oxley.

Dr. Abbe, of the University of Jena, gave an explanation of "A General Law of Aplanatic Systems."*

The President having invited remarks on Dr. Abbe's communication:—

* This communication will be published in a future number of the "Journal."

Dr. Matthews said there were some subjects which were utterly above discussion, and this appeared to be one of them, because it was a statement of facts—not theories—and facts of a most useful kind.

Mr. Ingpen said that, although the subject was such an extremely abstruse one in theory, its practical applications were very pretty and interesting; he expected to be able to show these at a future meeting. He hoped, therefore, that meanwhile the members would endeavour to bear the facts in mind.

The President said that, difficult as mathematics might be, the English language was said to be more difficult still, and he thought, therefore, that they might well congratulate Dr. Abbe upon his complete mastery of it. A vote of thanks to Dr. Abbe was then put and carried unanimously.

Mr. T. C. White, in communicating some remarks upon *Drosera rotundifolia*, apologised for the meagre facts he was about to bring before the meeting, explaining that his action only sprang out of a desire that any matters which arose out of the excursions of the Club should be brought under the notice of the members generally. Those who went on the excursion to Keston were rewarded by finding the *Drosera rotundifolia*. Owing to the unfavourableness of the season, it was very backward, and the plants found were very small, but he brought some home and had examined them for the purpose of ascertaining what was the mechanism of the tentacles. When he first got them the leaves were small, and of a pale green colour, but he found that as they grew the red tints spread over them. The first thing that would strike the observer would be the curious circumstance that when an Aphis was placed upon the leaf the tentacles curved themselves over upon it until at last the whole leaf became closed over it. The tentacles appeared to be of two kinds (drawn on board, and described as the drawing progressed), the longer ones had globular summits, and the centre of the globule was composed of red granular matter, and it seemed as if it was this globular matter which was sticky. By taking one of the tentacles and examining it he found that it contained some spiral vessels, which after running in various directions converged and ran down to the leaf. Were these the means by which the nutriment was conveyed down the leaf to nourish the plant? The next thing which struck him was that there were also upon the leaf a number of things like stomata, standing up from the surface in such a way that at first sight they might be taken for abortive hairs. On examination he thought that they were really stomata, although he found that there were other stomata as well as these upon other portions of the leaf.

The President invited remarks upon the subject. He had not examined the leaf, and therefore could not speak from observation, but he should think, on general principles, that the spiral vessels had nothing to do with the nutriment of the plant, because all spiral vessels, so far as he knew, were found to be filled with air.

Mr. T. C. White said if they were not for this purpose, he could not see why they ran down the stem.

Mr. W. H. Gilburt said he had listened to Mr. White's description of the *Drosera* leaf, and having spent some considerable time in its study, perhaps a few words from him might be of use. Mr. White had referred them to the back of the tentacles in order to see the spiral cells which they contain, but if they would prepare the leaf properly they would have no difficulty in making out the whole of its structure. The outer layers of the swollen ends of the tentacles consist of a double series of thin walled cells, the interior being wholly composed of the spiral cells described by Mr. White. These spiral cell-groups would remind one acquainted with leaf structure, of the groups of cells which form the free terminations of the veins in most leaves; and which were first described by Herbert Spencer, and called by him absorbents. Whether they were to be so regarded was difficult to say, but most authorities were doubtful on the point. In the case of the *Drosera*, however, he thought they might infer that they were not absorbents, but secreting organs—those which gave out the sticky fluid. With reference to the organs which Mr. White had seen, together with stomata, between the "upstanding tentacles" on the surface, they were, he believed, the true absorbing glands of the leaf. These glands are elliptical in form, divided into two along their major axis. He thought, therefore, that it might be taken as correct that the glands on the top of the tentacles were the secreting ones, and that the sessile surface glands were the absorbents.

Mr. Hardy enquired whether Mr. Gilburt had traced the spiral vessels down into the leaf?

Mr. Gilburt said he had; and regarded them as simply a continuation of the vascular system of the leaf. He quite agreed with the President that they had no such function as the conveyance of nutriment.

The President said he should like to ask Mr. Gilburt whether he did not think that there was a little difficulty in the way of ascribing secreting functions to these cells? In the general way they would find in the case of secreting tissues that the walls were not greatly thickened, and then it was not usual for a cell, which had a certain work to do, to spend itself in doing something else. Was there any reason to suspect that these cells, which had their walls spirally thickened, contained air? And might they not have a function of supplying air to the secreting tissues, which were possibly situated in a more superficial layer of cells, so that the spiral tissue might act as supporting tissue? Of course these were merely suggestions, and would weigh nothing against positive evidence.

Mr. Gilburt said he had never seen them containing air, and they were always soft and succulent. The spiral thickening was not so well marked as those of spiral vessels. They were altogether so different from anything else with which he was acquainted, and seeing that they contained protoplasm more or less granular, and not air, and that the secretion was so abundant, he took it that the whole structure was glandular in character.

Mr. T. C. White said he must differ on one point from Mr. Gilburt, that as to the "dewdrop" being a drop of fluid only, for by some of the means which he had used he had distinctly seen a cell wall or limiting mem-

brane enclosing the drop at the end of the tentacle. There was another point upon which some light was wanted; when they saw an insect crawl upon the leaf these tentacles bent over to it so like the movement in *Actinia*, that one almost began to suspect muscular action. And the question was what made them bend over?

The President said with regard to Mr. White's last question, the answer to it was one which they would all like to know. In the animal world contractility appeared to be restricted to protoplasmic matter. In plants they seemed to have two alternatives, either the power resided in the protoplasmic contents, or in the cell wall. If it resided in the protoplasmic contents, then the question arose, how was the stimulus to be conveyed? And how did the contraction produce its mechanical effect? The second alternative was that the change of form might lie in the cell wall. If this was the case, then there was no analogy to be found to it in the animal world. One of the most curious things about the matter was that they had in these contractile parts of plants the same disturbance of the electrial conditions as in the case of animals.

The thanks of the meeting were, on the motion of the President, voted to Mr. White and the other gentlemen who had spoken on the subject.

Announcements of excursions, &c., for the ensuing month were then made, and the proceedings terminated with the usual Conversazione, at which the following objects were exhibited:—

Under cuticle of Bay Leaf	Mr. F. W. Andrew.
Young Mussels	Mr. T. Curties.
Lycosa agretyca, the Ground Spider, in the act of moulting, showing the claws, falces, &c., in duplicate	Mr. F. Enock.
Horizontal section of foot of Human Fœtus	Mr. J. J. Hunter.
"Shepherds purse" Zoophyte	Mr. A. Martinelli.
Catemcela hastata polyzoa	Mr. T. S. Morten.
Cicendela campestris	Mr. J. M. Offord.

Attendance.—Members, 82; Visitors, 7.

July 11th, 1879.—Conversational Meeting.

The following objects were exhibited:—

Leaf of Mustard	Mr. F. W. Andrew.
Erotium herbariorum, fungus of *Cacao theobroma*	Mr. H. Epps.
Pollen of *Carex acuta*	
Spores of *Equisetum sylvaticum* ...	
Arachnoidiscus in situ on Seaweed from Natal	Rev. H. J. Fase.

Eggs of unknown water insect	Mr. J. W. Goodwin.
Leaf of *Drosera rotundifolia*, showing glands	Mr. J. D. Hardy.
Young Leech	Mr. F. C. Kellow.
Fredericella sultana	Mr. C. Le Pelley.
Amœba	Mr. A. Martinelli.
Cothurnicella cordieri (Savigny) ... An African Polyzoan, of which only two or three specimens are believed to be in this country. The genus contains only two known species	Mr. A. D. Michael.
Section of Flint, containing *Xanthidiæ* ...	Mr. H. Morland.
Dessicated Human Saliva, showing its arborescent character	Mr. J. C. Sigsworth.

Attendance—Members, 57; Visitors, 6.

July 25th, 1879.—Anniversary Meeting.

Prof. Huxley, F.R.S., President, *in the Chair.*

The minutes of the preceding Meeting were read and confirmed.

The following gentlemen were balloted for, and duly elected Members of the Club:—Mr. Arthur Ashbridge, Dr. T. Spencer Cobbold, Mr. Alfred Driver, Mr. Geo. G. Hardingham, Mr. Greville H. Palmer, Mr. Chas. V. Smith, Mr. Edward M. Stone and Mr. Thos. L. Waterman; also, as Honorary Members, Prof. Abbe, of Jena, and Dr. W. B. Carpenter

Eight gentlemen were proposed for membership.

The following list of donations to the Club was read:—

"Proceedings of the Royal Society" ...	from the Society.
„ „ Watford Natural History Society"	„ „
"Transactions of the New York Microscopical Society"	„ the Society.
"The Popular Science Review"	„ the Publisher.
"Science Gossip"	„ „
"The Analyst"	„ „
Translation of Michelet's Works on "Insects"	from Mr. Sigsworth.
"Catalogue of the General Library of University College"	„ the College.
"Smithsonian Reports for 1877"	„ the Institution.
"The American Naturalist"	in Exchange.
"The Midland Naturalist"	„ „

"Quarterly Journal of Microscopical Science"	by Purchase.
"Annals of Natural History"	„ „
Three Slides of Fungi	from Mr. Epps.
Three Slides—sections of Brain of Cockroach	„ Mr. E. T. Newton.

The thanks of the Club were unanimously voted to the donors.

Announcements of meetings, &c., for the ensuing month were made, and the business of the Ordinary Meeting being then completed, that of the Annual Meeting commenced.

The Secretary reminded the Members that notice was given at the last meeting of the proposal by the Committee to alter Rule 2, in such a way as to enable the Club to appoint more than one Secretary if they pleased. He now, on behalf of the Committee, moved a resolution to that effect.

Dr. Matthews, in seconding the motion, said that there appeared to be some difficulty in the way of appointing a second Honorary Secretary at once, but it seemed to him that it was very desirable that whoever was elected should have his name printed in the list of officers elected at that meeting. He therefore proposed that the election of an additional Secretary be proceeded with at once.

Mr. Goodinge seconded the proposal, and moved further that Rule 3 be suspended to enable them to carry out the matter. He thought that any Society could suspend its standing orders if need arose.

Mr. Hainworth said they could do so, but notice must be given of their intention.

The President said that no one was less fond of red tape than himself, but he thought for all that, it would be a very undesirable thing for the Club to break its own rules. There was no doubt as to what Rule 3 meant; it was intended to prevent surprise, and was, no doubt, a very wise rule. Now it was inadvisable to go in the teeth of a rule. The next question that arose was whether the Annual Meeting was competent to alter or suspend a rule? He confessed that he saw nothing stated about any suspension of rules, and he found that Rule 12 provided for the way in which alone alterations were to be made. Being a very law-abiding man himself, he thought he was bound to advise them not to interfere with the rules except in the manner provided.

Mr. Gilburt suggested that Mr. Hailes' name should be entered on the list, and that he be elected afterwards.

Mr. A. D. Michael thought this might be done—adding a note, "elected in August.'

Mr. Curties said that the only object seemed to be that of publishing the name in the list of officers; but, as there was not likely to be anything published until after the next Ordinary Meeting, he hardly saw why there need be any difficulty in the matter.

Dr. M. C. Cooke said there would be none provided they could nominate Mr. Hailes that night.

The Secretary said they could not nominate him, because the rule had not

yet been altered to enable them to do so, and the nomination must be by the Committee.

Dr. Matthews said he knew that their present Secretary was somewhat overweighted, and therefore he was very desirous of affording him some relief as soon as it was possible to do. This was his object in bringing the matter prominently before them. He withdrew his motion.

The President wondered if there was such a thing as a Suffragan Secretary, as he had heard of Suffragan Bishops. If the Committee took upon themselves to appoint Mr. Hailes, the confirmation of their act might be considered afterwards, but on the whole he thought it best to keep to the rule as they found it, for it was always an unwise thing to make precedents of this kind, not knowing what they might some day lead to.

The Secretary read the Annual Report of the Committee, also the Treasurer's Annual Statement of Accounts duly audited.

The President said that, having heard these reports, he begged to move that they be received and adopted, and that they be printed and circulated in the usual way.

Dr. Matthews having seconded the adoption of the report, the motion was put to the meeting and carried unanimously.

Mr. Curties and Mr. Reeves were then requested by the President to act as Scrutineers, and the ballot for Officers and Committee was proceeded with.

The President then delivered the Annual Address, which was listened to with marked attention, and warmly applauded at its conclusion.

Dr. Matthews said that a duty devolved upon him which, at the end of such a discourse as that to which they had just listened, became an intense pleasure. The address to which they had just been listening had been of the most valuable description, and had certainly not been surpassed in interest by anything which they had heard from that chair. He begged to move that a cordial vote of thanks be given to the President for his address, and that he be requested to allow it to be printed with the Annual Reports.

Mr. T. C. White seconded the motion, and observed that this certainly was one of the best addresses they had heard in that place; it had indicated lines of action which the members of the Club would do well to follow out, and he was fully persuaded that their President's words that evening would bear good fruit for many years to come.

The Secretary said that it was his pleasing as well as formal duty to put to the meeting the motion of Dr. Matthews, which had been seconded by Mr. White.

The vote of thanks was at once carried by acclamation.

The President said that the Members of the Club were aware to whom they were indebted for the opportunity of meeting in that room, and he had now the pleasure of proposing a vote of thanks to the Council of University College for their continued permission to meet in the building.

Mr. Ingpen seconded this vote of thanks, remarking that, having come more into communication with the Officers of the College than any one else

had done, he could best bear testimony to the kindness and courtesy with which he had always been received, and to the manner in which every thing in their power had been done for the convenience and comfort of the Members of the Club.

The vote of thanks was then put and carried unanimously.

A vote of thanks to the President, Committee and Officers of the Club for their efficient services during the past year, was moved by Mr. J. G. Waller, seconded by Mr. Guimaraens, and carried unanimously.

A vote of thanks to the Auditors and Scrutineers, proposed by Mr. T. C. White, and seconded by Mr. E. T. Newton, was also put and duly carried.

The President then announced the result of the ballot for Officers and Committe for the ensuing year, to be as follows :—

President.	T. Spencer Cobbold, M.D., F.R.S., F.L.S., &c.
Vice-Presidents.	T. H. Huxley, LL.D , F.R.S., &c. John Matthews, M.D., F.R.M.S. A. D. Michael, F.R M.S. Charles Stewart, M.R.C.S.., F.L.S., F.R.M S.
Hon. Treasurer.	F. W. Gay, F.R.M.S.
Hon. Secretary.	J. E. Ingpen, F.R.M.S.
Hon. Foreign Secretary.	M. C. Cooke, M.A., LL.D., A.L.S.
New Members of Committee	Ferdinand Coles, F.L.S. Arthur Cottam, F.R.A.S. Edward Dadswell. J. W. Groves. J. W. Reed, F.R.G.S. J. C. Sigsworth, F.R.M.S. T. C. White, M.R.C.S., &c.

The proceedings then terminated with the usual Conversazione.

Attendance—Members, 94; Visitors, 16.

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MICROCIONA BIHAMIGERA.

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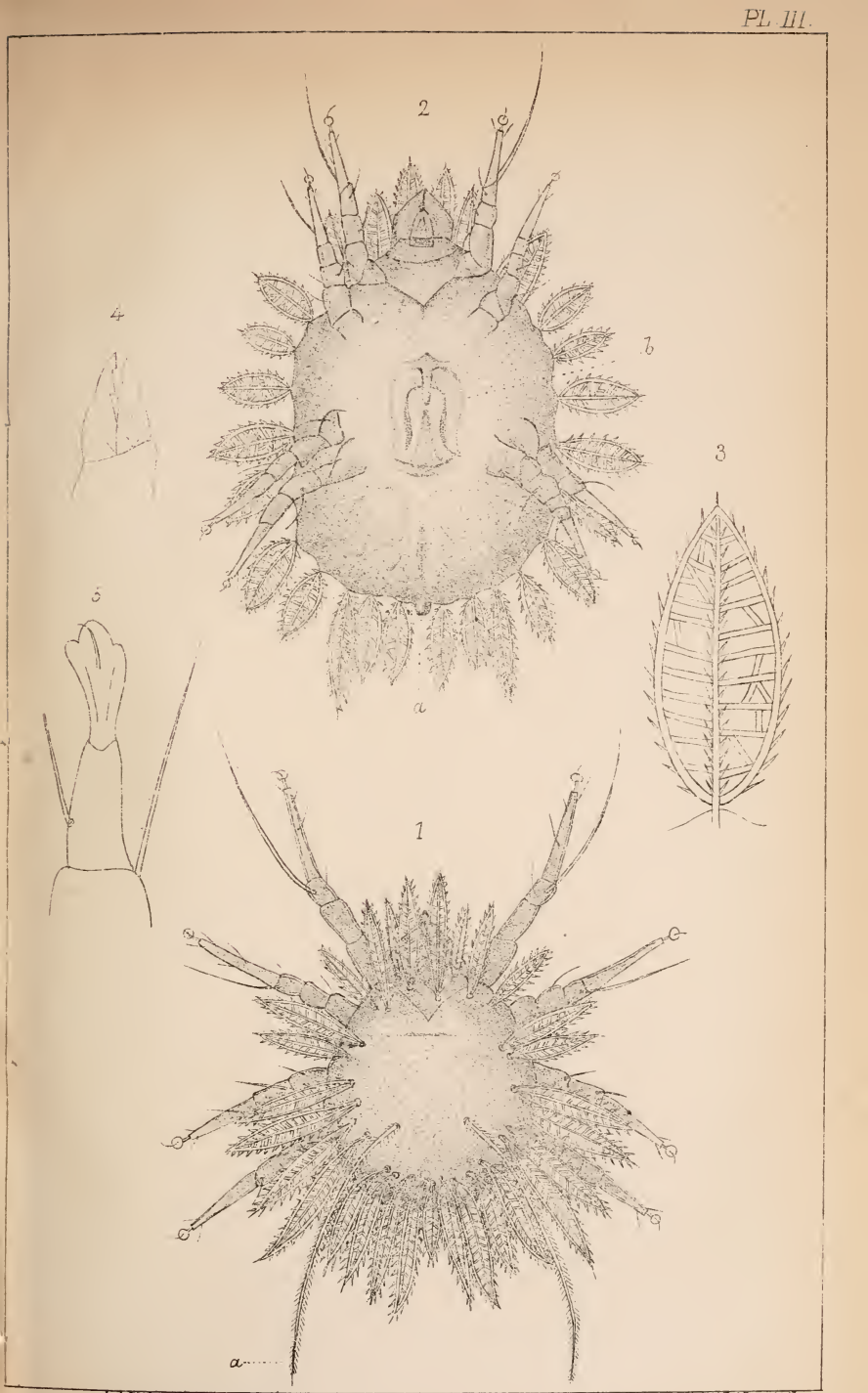

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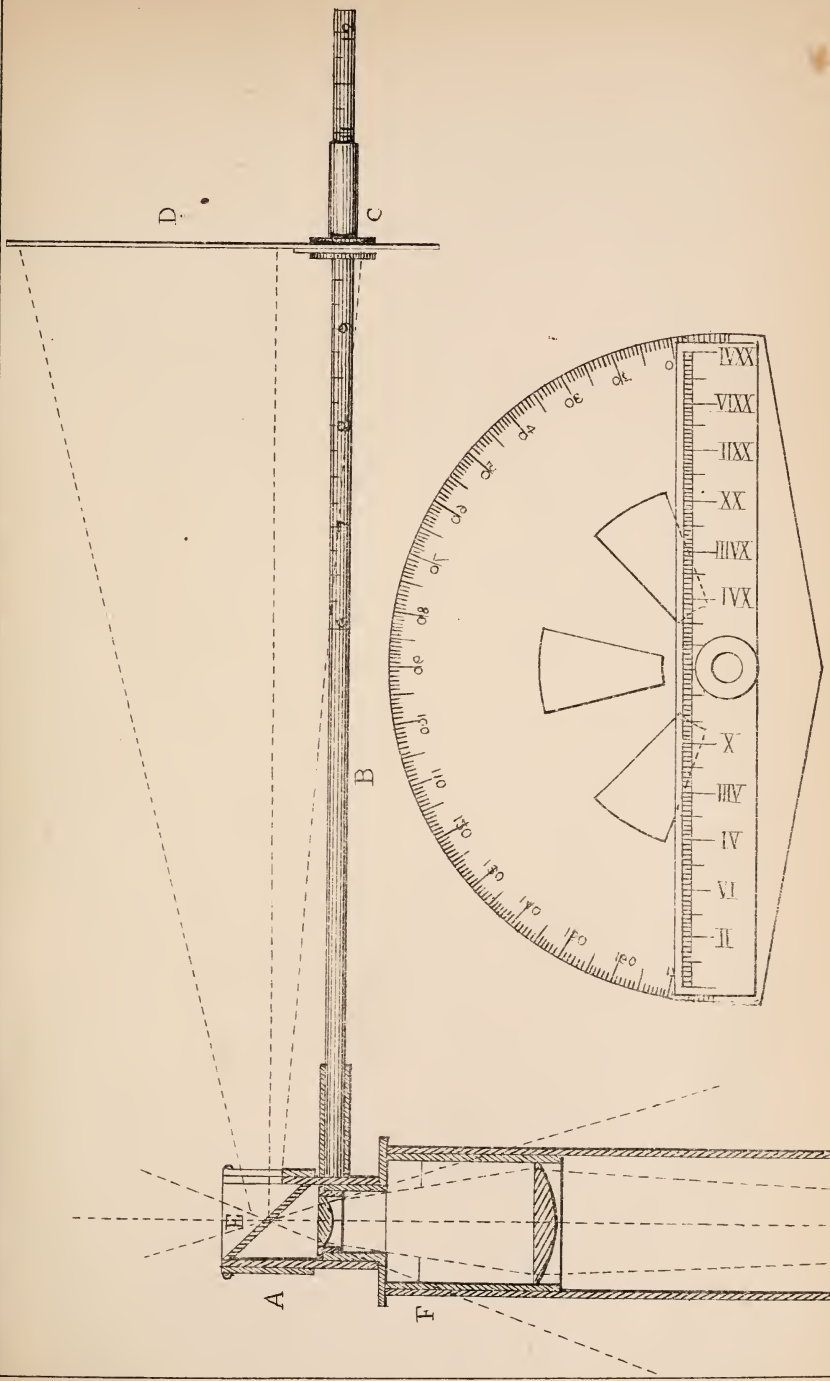
E. Cooke. lith



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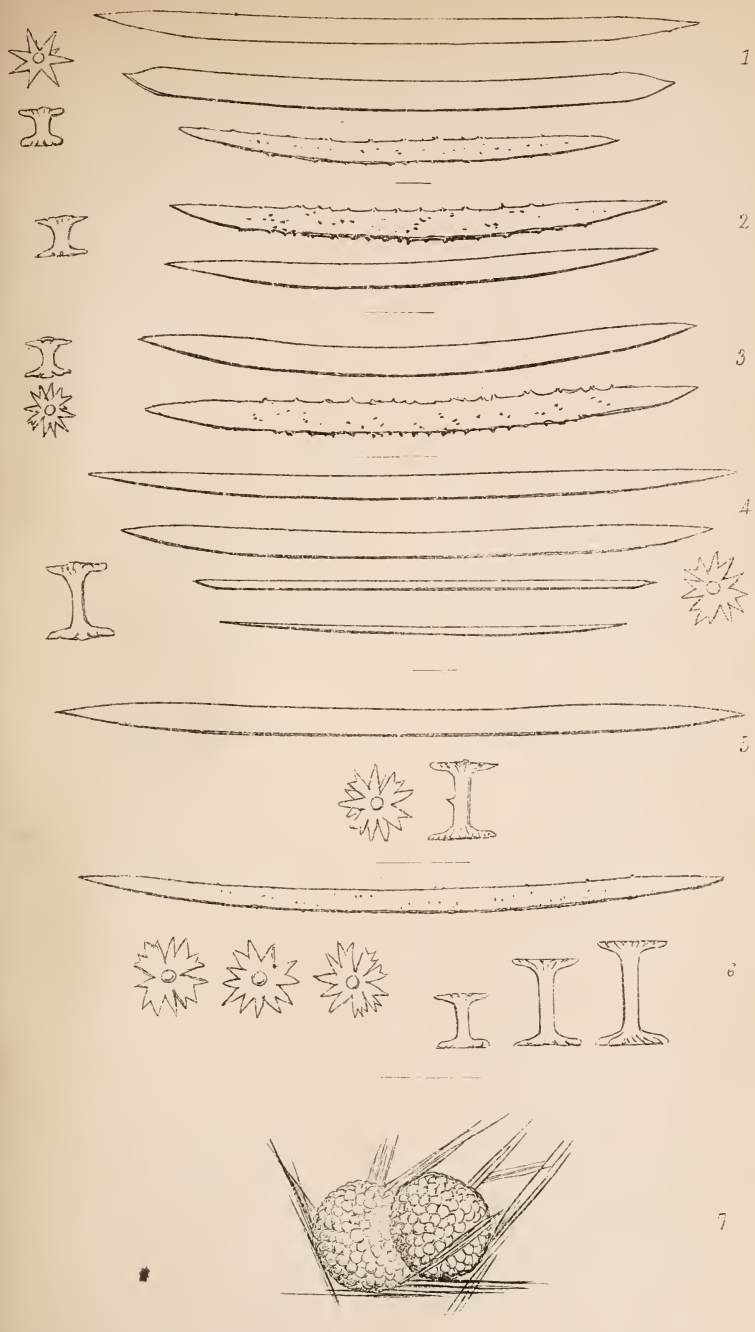

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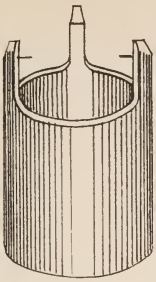

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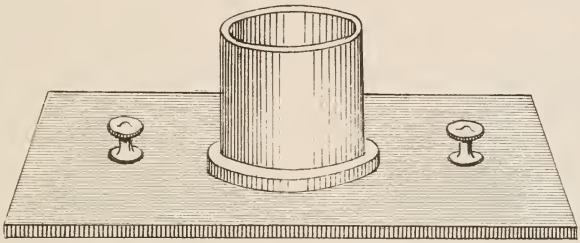

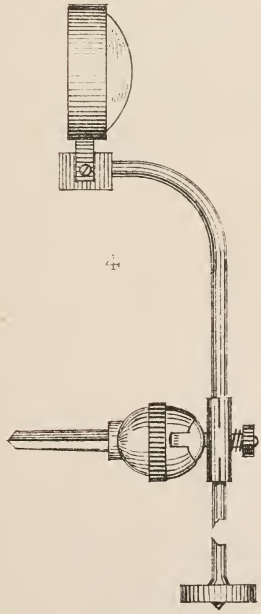

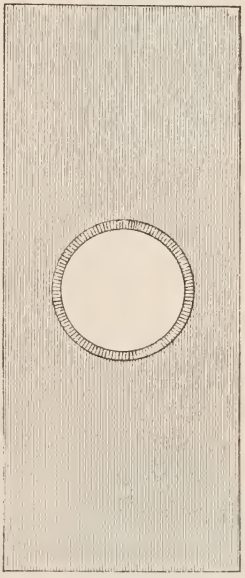

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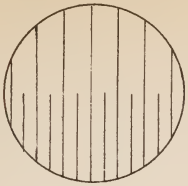

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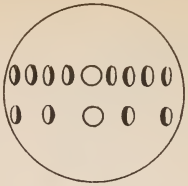

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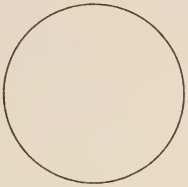

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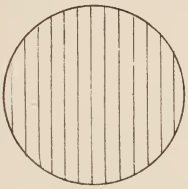

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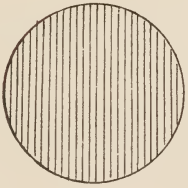

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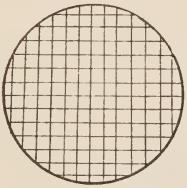

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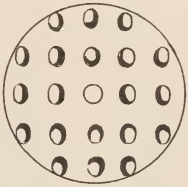

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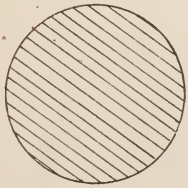

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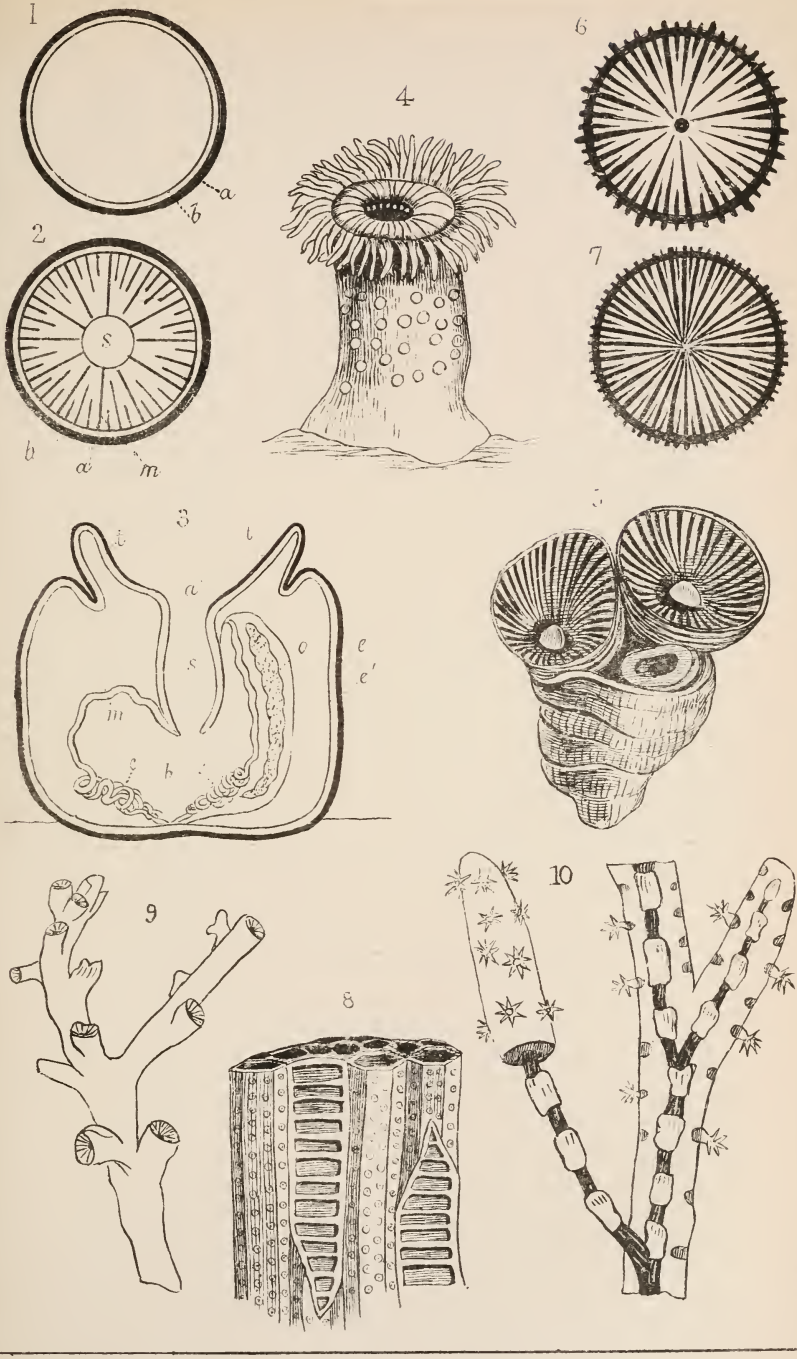
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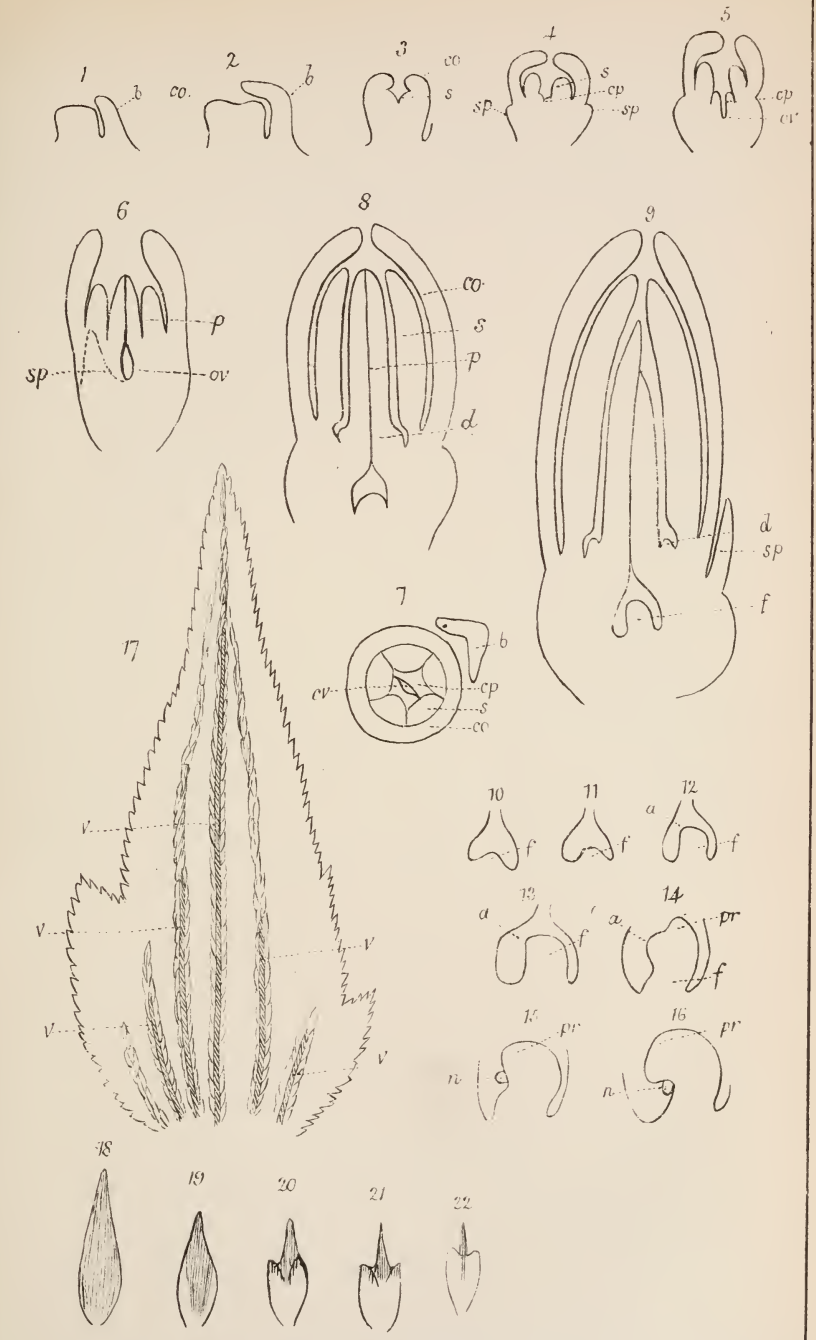

W. H. Gilbert del.

T. Cooke lith.

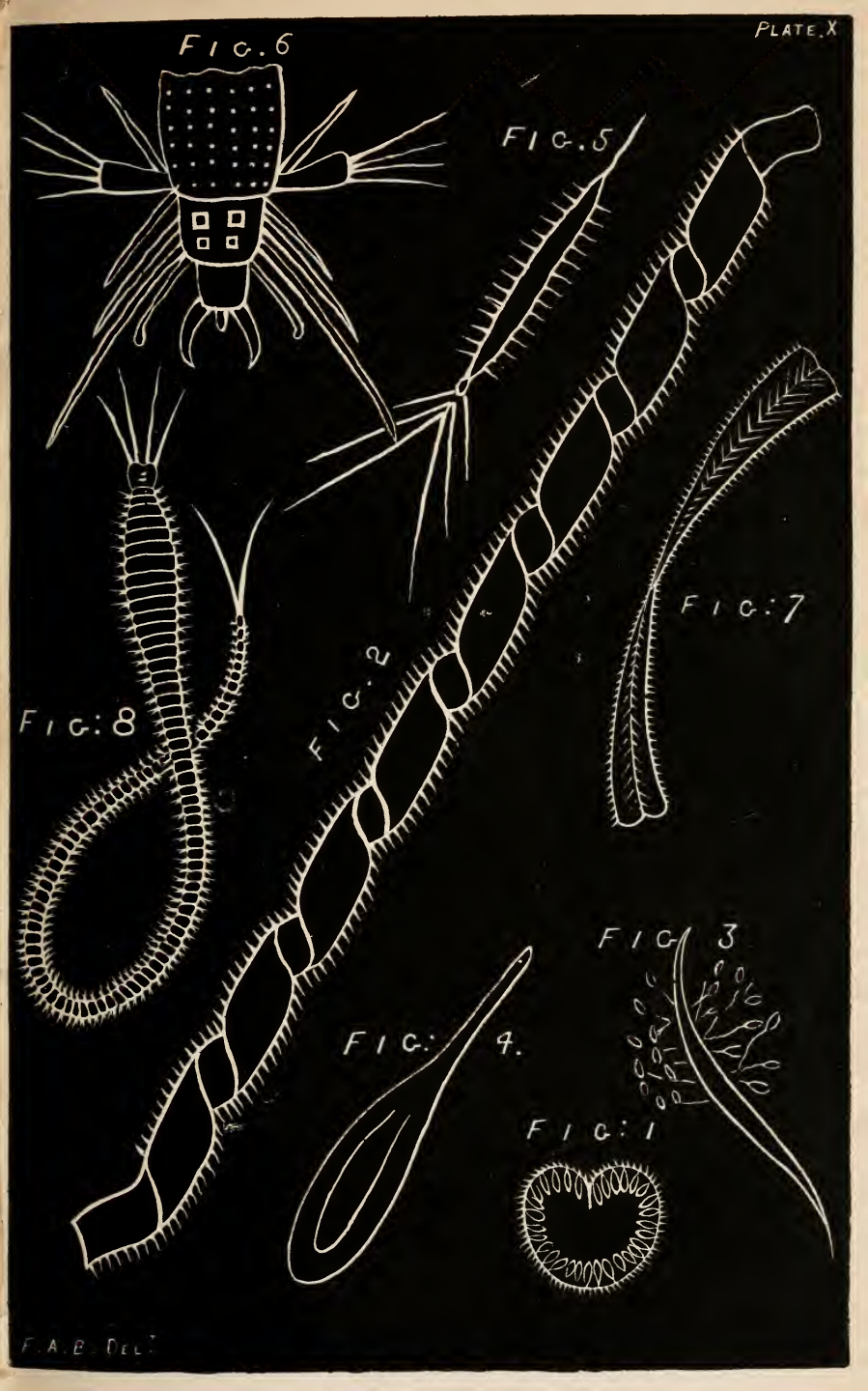
FIG. 6
FIG. 5
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FIG. 3
FIG. 4.
FIG. 1
F. A. B. DEL.

FIG. 1.

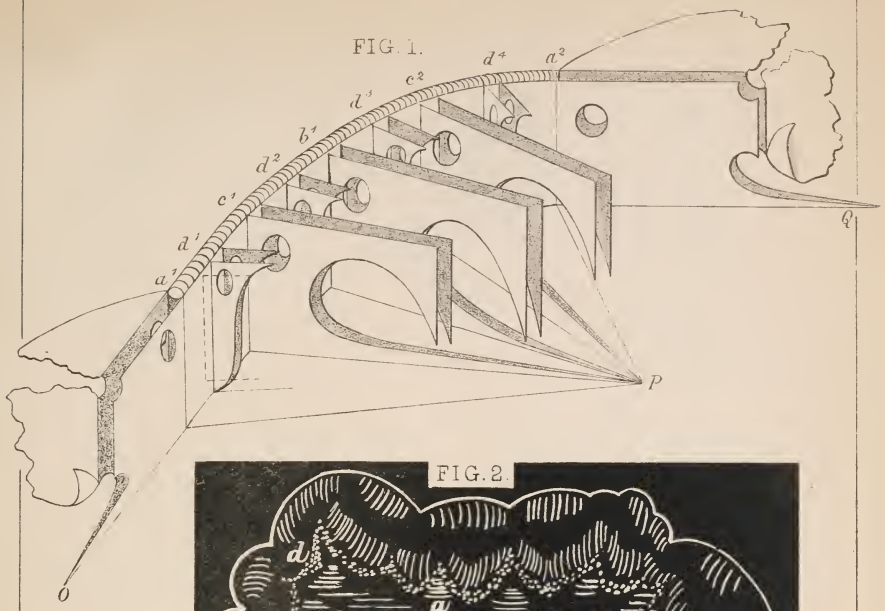


FIG. 2.

FIG. 3.

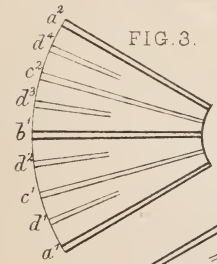


FIG. 4.

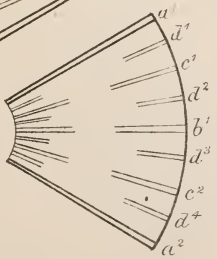
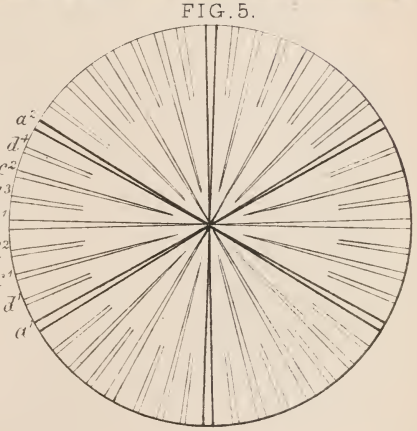


FIG. 5.



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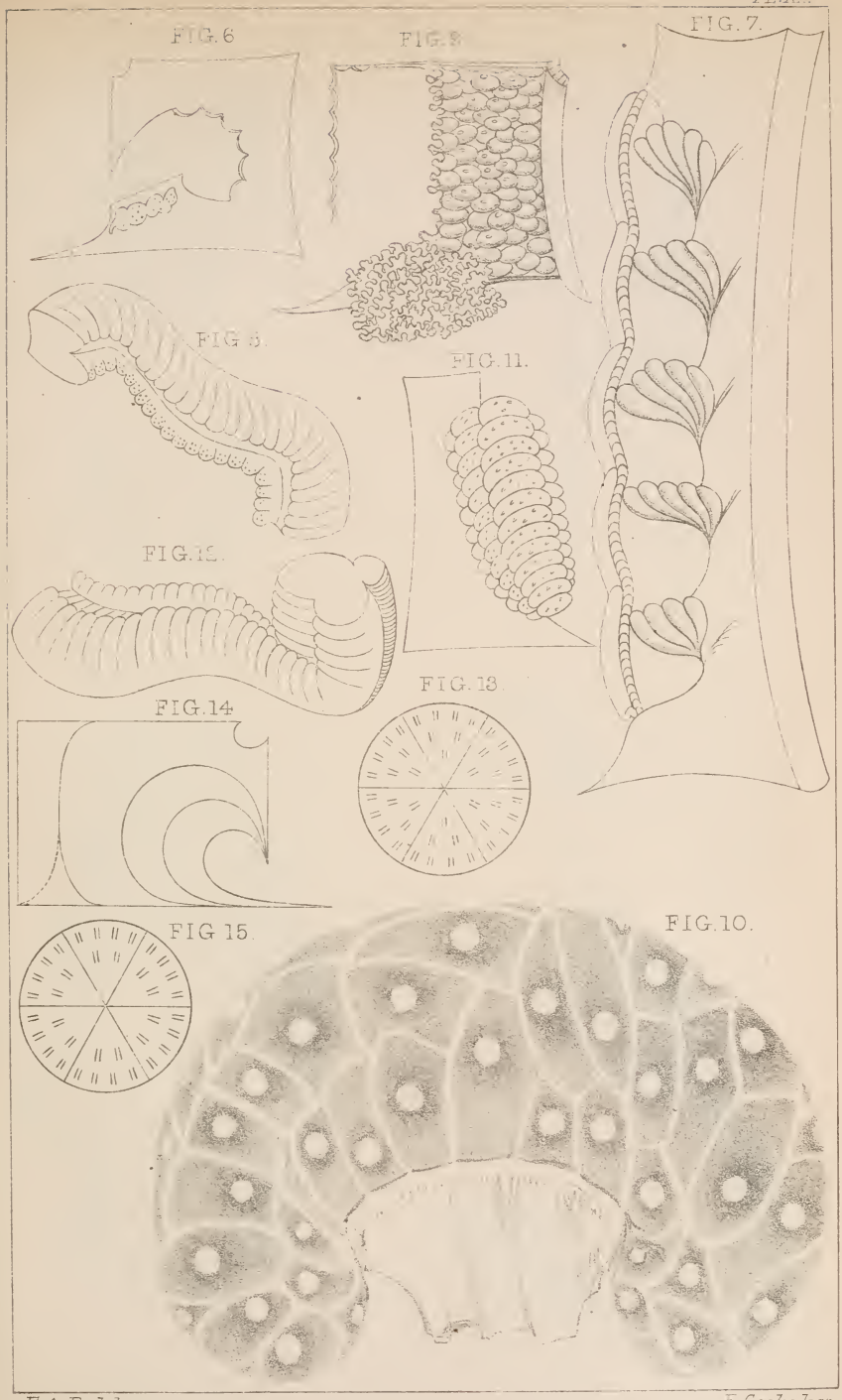
E. Cooke, Lith.



F. A. B. del.

E. Cooke lith.

FIG. 1.

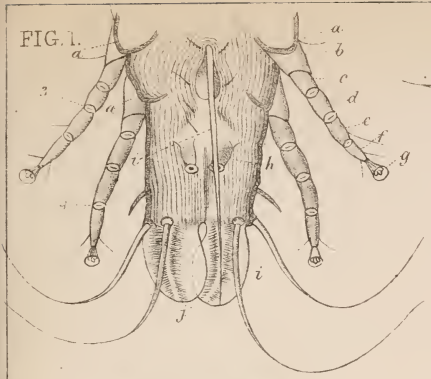


FIG. 2.

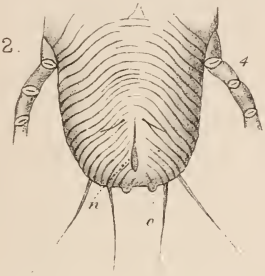


FIG. 3.

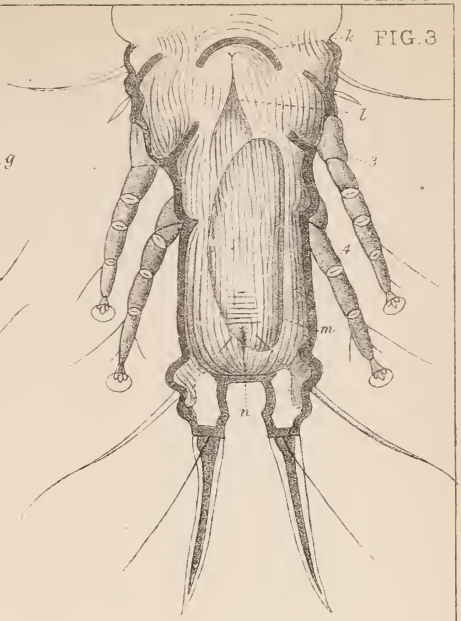


FIG. 4.

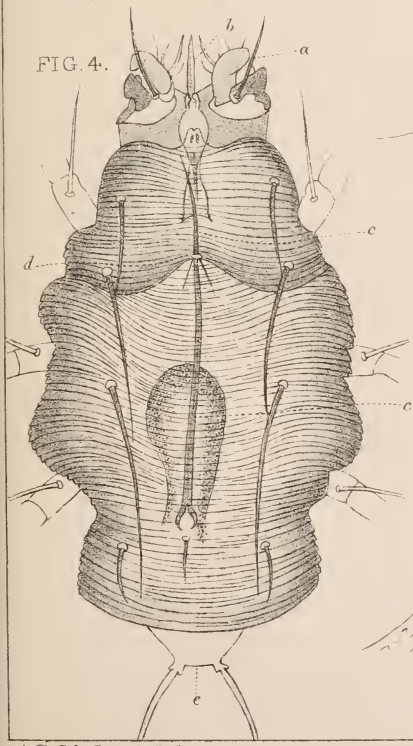


FIG. 5.

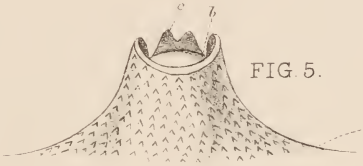


FIG. 7.

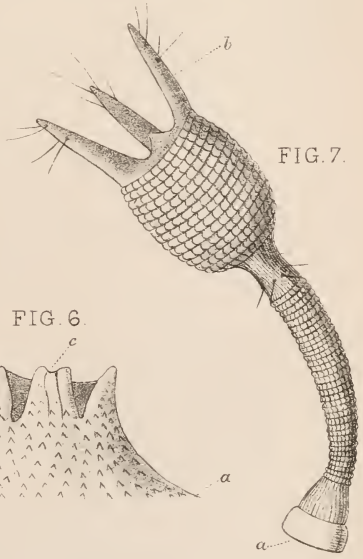


FIG. 6.

FIG. 1.

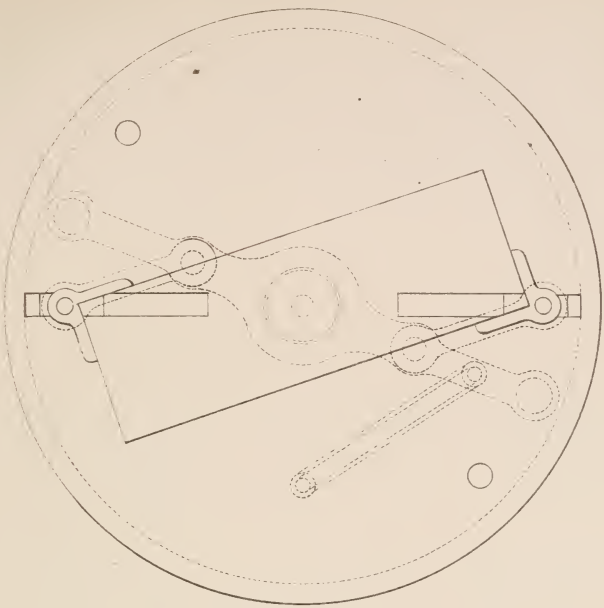
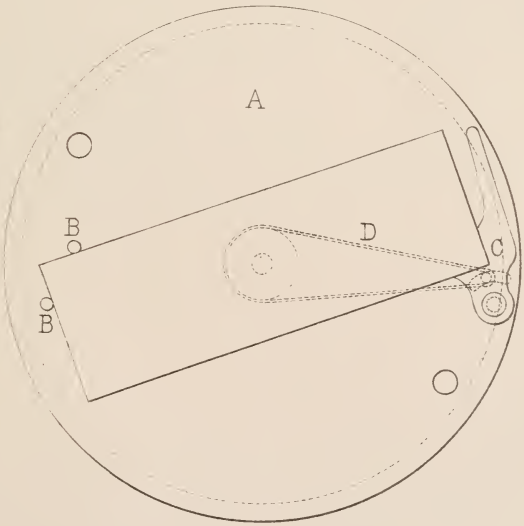


FIG. 2.



DESCRIPTION OF PLATES XI. AND XII.

Fig. 1.—Diagrammatic representation of a sextant in *Actinia*.—(*a*) Primary, (*b*) Secondary, (*c*) Tertiary, and (*d*) Quaternary septa.

Figs. 2 & 8.—Fluted organ of *A. mesembryanthemum* (see text).—(*a*) Septum, (*d*) White spots.

Fig. 3.—Transverse section of a sextant of *A. mesembryanthemum*, made half-way down.

Fig. 4.—Ditto, made close under the disc.

Fig. 5.—Base of ditto.

Fig. 6.—Tertiary septum of *A. mesembryanthemum*, with eggs; craspedum cut away; fluted organ in wavy line.

Fig. 7.—Quaternary septum of *S. parasitica*; early ovarian stage (September). No craspedum carried by this septum, fluted organ seen lifted up.

Fig. 9.—Quaternary septum of *T. crassicornis*; craspedum at foot and edging septum, and followed by fluted organ running to back of stomach wall; eggs cover septum.

Fig. 10.—Eggs of *S. parasitica*.

Fig. 11.—Quaternary septum of *S. parasitica*; advanced ovarian stage (November); fluted organ removed.

Fig. 12.—Fluted organ in *S. parasitica*, showing keel-like process.

Fig. 13.—Marks seen through disc of *A. mesembryanthemum* (see text).

Fig. 14.—Relative shapes of the four septa in ditto.

Fig. 15.—Marks seen through disc of *S. parasitica*.

THIRTEENTH REPORT

OF THE

QUEKETT MICROSCOPICAL CLUB,

AND

LIST OF MEMBERS.

Meeting at University College, London, on the Second and Fourth Fridays of Every Month.

LONDON.

July 1878.

(*Extract from original Prospectus, July* 1865.)

"The want of such a Club as the present has long been felt, wherein "Microscopists and students with kindred tastes might meet at stated periods "to hold cheerful converse with each other, exhibit and exchange specimens, "read papers on topics of interest, discuss doubtful points, compare notes of "progress, and gossip over those special subjects in which they are more or "less interested: where, in fact, each member would be solicited to bring his "own individual experience, be it ever so small, and cast it into the treasury "for the general good. Such are some of the objects which the present Club "seeks to attain. In addition thereto it hopes to organize occasional Field "Excursions, at proper seasons, for the collection of living specimens; to "acquire a Library of such books of reference as will be most useful to "enquiring students; and, trusting to the proverbial liberality of Micro- "scopists, to add thereto a comprehensive Cabinet of Objects. By these and "similar means, the Quekett Microscopical Club seeks to merit the support "of all earnest men who may be devoted to such pursuits; and, by fostering "and encouraging a love for Microscopical studies, to deserve the approval "of men of science and more learned societies."

OFFICERS AND COMMITTEE.

(Elected July 1878.)

President.

PROFESSOR T. H. HUXLEY, F.R.S.

Vice-Presidents.

HENRY LEE, F.L.S., F.G.S., F.R.M.S., F.Z.S.
JOHN MATTHEWS, M.D., F.R.M.S.
CHARLES STEWART, M.R.C.S., F.L.S., F.R.M.S.
T. CHARTERS WHITE, M.R.C.S., L.D.S., F.R.M.S.

Hon. Treasurer.

F. W. GAY, F.R.M.S., 113, High Holborn, W.C.

Hon. Secretary.

JOHN E. INGPEN, F.R.M.S., 7, The Hill, Putney, S.W.

Hon. Secretary for Foreign Correspondence.

M. C. COOKE, M.A., LL.D., A.L.S.

Committee.

F. W. ANDREW.
A. COTTAM, F.R.A.S.
C. G. DUNNING.
J. W. GOODINGE, F.R.G.S.
W. H. GILBURT.
F. A. PARSONS.
B. W. PRIEST.
T. SPENCER, F.C.S., F.R.M.S.
FRANK CRISP, LL.B., B.A., &c.
A. D. MICHAEL, F.R.M.S.
E. T. NEWTON, F.G.S.
FREDERICK OXLEY.

Hon. Reporter.

RICHARD T. LEWIS, F.R.M.S.

Hon. Librarian.

ALPHEUS SMITH.

Hon. Curators.

H. F. HAILES, CHARLES EMERY.

Excursion Committee.

F. W. GAY, F.R.M.S.
FREDERICK OXLEY.
W. W. REEVES, F.R.M.S.
T. ROGERS, F.L.S., F.R.M.S.
JAMES SPENCER, F.R.M.S.

PAST PRESIDENTS.

	Elected.
EDWIN LANKESTER, M.D., F.R.S. - -	July, 1865.
ERNEST HART - - - - - - -	,, 1866.
ARTHUR E. DURHAM, F.L.S., &c. - -	,, 1867.
,, ,, ,, - - -	,, 1868.
PETER LE NEVE FOSTER, M.A. - -	,, 1869.
LIONEL S. BEALE, M.B., F.R.S., &c. -	,, 1870.
,, ,, ,, - - -	,, 1871.
ROBERT BRAITHWAITE, M.D., F.L.S., &c.	,, 1872.
,, ,, ,, - - -	,, 1873.
JOHN MATTHEWS, M.D., F.R.M.S. - -	,, 1874.
,, ,, ,, - - -	,, 1875.
HENRY LEE, F.L.S., F.G.S., F.R.M.S., F.Z.S.	,, 1876.
,, ,, ,, - - -	,, 1877.

REPORT OF THE COMMITTEE.

Your Committee, in presenting their Thirteenth Annual Report, are glad to be able to record a continuance of the prosperity which has attended the Club from its commencement.

The permission of the Council of University College for holding our meetings here, has been again renewed for the ensuing year, with the courtesy that the Club has always received from them. Your Committee have deemed the present a suitable time for expressing their appreciation of this favour, by making, on behalf of the Club, a donation of £20 towards the new University Buildings just commenced. They feel sure that this will meet with the approbation of the Members.

The Club has lost three Members by death during the past year—Captain J. C. Bailey, Mr. R. G. Pearcy and Dr. Thomas Pritchard. Seventeen Members have resigned; nine have been struck off the list for non-payment of their subscriptions for four years and upwards; forty-nine new Members have been elected, making our present numbers 562.

The work done by the Club during the past year has been satisfactory. Its value will be sufficiently apparent by reference to it under the usual heads.

The following papers have been read, and oral communications made at the meetings during the past year:—

On the Histology of the Human Skin ...	*By Mr. Chas. Stewart.*
„ A New Immersion Paraboloid	„ *Dr. James Edmunds.*
„ A New British Sponge	„ *Mr. J. G. Waller.*
„ The General Characteristics of Sponges	„ *Mr. Chas. Stewart.*
„ The New Autographic Process	„ *Mr. A. Cottam.*
„ The Investigation of Floral Development	„ *Mr. Marcus M. Hartog.*
„ *Glyciphagus palmifer*	„ *Mr. A. D. Michael.*
„ Insect Dissection.....	„ *Mr. T. Charters White.*
„ Microscopical Tracings of Lissajous' Curves.....	„ *Mr. Robt. G. West.*
„ A New Micrometer.....	„ *Mr. G. J. Burch.*
„ Mounting whole Insects without pressure	„ *Mr. Staniforth Green.*
„ Variation in *Spongilla fluviatilis*	„ *Mr. J. G. Waller.*
„ An Apparatus for facilitating the use of Powell's Small Bull's-eye Illuminator	„ *Mr. George Williams.*
„ The Structure of the Eyes of Insects	„ *Mr. B. Thompson Lowne.*
„ The Influence of Diffraction in Microscopic Vision	„ *Mr. Frank Crisp.*

Besides the above, several short notes upon various subjects have been communicated, and are reported in the Proceedings.

The following additions have been made to the Library, by donation, exchange and purchase :—

	PRESENTED BY
Murray (A.), Economic Entomology	*Mr. J. C. Sigsworth.*
Maclise (J.), Comparative Osteology	*Mr. W. J. Scofield.*
Leifchild (J. R.) On Coal	*The Author.*
Baker (H.), The Microscope made easy Third Edition.....	*Mr. M. Hawkins Johnson.*
Do. Natural History of the Polype	„ „
Brongniart (A.), Traité élémentaire de Minéralogié. 2 Vols.	„ „
Say (T.), American Entomology. 3 Vols.	*Mr. Hy. Lee.*
Lee (H.), Aquarium Notes—The Octopus	*The Author.*
Thudichum (J. L. W.), Manual of Chemical Physiology	*Mr. H. E. Freeman.*

Habirshaw (F.), Catalogue of the Diatomaceæ	*The Author.*
Wallich (G. C.), The North Atlantic Sea Bed, &c. Part I.	„
Harting (P.), De Nieuwste verbeteringen van het Mikroskoop	*Mr. Frank Crisp.*
Donné (A.), Cours de Microscopiê	„ „
Martin (B.), A New and Compendious System of Optics	„ „
Do. Introduction to the Newtonian Philosophy	„ „
Lardner (D.), Handbook of Natural Philosophy—Optics	„ „
Goring (C. R.), Microscopic Illustrations of Living Objects	„ „
Hogg (J.), The Microscope. Third Edition	„ „
Smithsonian Institution Report for 1876	*United States' Government.*
Popular Science Review	*The Publisher.*
Science Gossip	„
Monthly Microscopical Journal—Completion	„
Le Maout, E. & Decaisne J., General System of Botany, translated by Mrs. Hooker	*Purchased.*
Huxley (T. H.), Manual of the Anatomy of Invertebrated Animals	„
Ehrenberg (C. G.), Mikrogeologische Studien. 2 Vols.	„
Quarterly Journal of Microscopical Science	„
Annals of Natural History	„
Grevillea	„
American Naturalist	*In Exchange.*
American Journal of Microscopy	„
Proceedings of various Scientific Societies and Sundry Pamphlets	„

The following Donations have been made to the Cabinet:—

Mr. Beulah	... ...	12 Slides.
„ Buffham	... ...	6 „
„ A. C. Cole	... ...	15 „
„ F. Coles	... ...	10 „
„ Curties	... ...	24 „
„ Gilburt	... ...	12 „
„ Glasspoole	... ...	3 „
„ Gregory	... ...	1 „
„ Hailes	... ...	12 „
„ J. Hunter	... ...	24 „
„ J. E. Ingpen	... ...	8 „
„ Michael	... ...	16 „
„ Moginie	... ...	1 „
„ Newton	... ...	22 „
„ Priest	... ...	2 „
„ Tatem	... ...	12 „
„ Topping	... ...	1 „
„ Waller	... ...	4 „
	Total	185

Thirteen portraits have been added to the Album.

Mr. Henry Crouch has presented a large and valuable Binocular Microscope Stand, forming an important addition to the resources of the Club, by placing it in possession of an instrument available for delicate investigations when required at the meetings. Mr. Wm. Wray has given a $\frac{1}{5}$ inch objective, of great excellence, and Mr. Swift some apparatus for use with the Curators' Microscope. Mr. M. J. Hallett has contributed to the "Museum" a Solar Microscope, by Adams, an instrument of interest from its connection with the early History of Microscopy.

The Sub-Committee appointed to revise the Collection of Objects, has given careful attention to the subject. A new catalogue of the Slides will very shortly be issued, and will

include the numerous specimens presented from time to time since the publication of the last catalogue. Objects which have become damaged and useless have been removed; additions have been made by donation and purchase in those sections which were before but scantily represented; and an approach has been made towards that most desirable acquisition—a good *type collection* of microscopical objects. The valuable additions made during the past year have greatly contributed to this. Besides the objects mentioned in the printed catalogue, many others which are of interest only to those following special branches of study are preserved, and are readily accessible.

The attendances at the Ordinary and Conversational Meetings have been very satisfactory: at the latter, the "Instructions on Elementary Subjects" have proved attractive, so much so as to warrant their continuation in the future, at suitable intervals. They are designed to give to those who may desire it, instruction in the rudiments of various subjects connected with microscopy, in such a manner as not to interfere in any way with the freedom and social character of the "Gossip Nights."

The Excursions have been fairly successful and well attended, showing that the old "hunting grounds" have not altogether lost their interest to microscopists. Introduction to new localities, easily accessible from London, would, however, be very desirable. The friendly feeling existing between the Club and the Societies whose members meet us on these occasions continues unabated.

The Journal contains, as heretofore, the papers read before the Club, and a record of its proceedings. In the four volumes now completed will be found much that is useful and interesting to the general Microscopist, as well as to Members of the Club.

The thanks of your Committee are gladly accorded to the Honorary Treasurer, Secretaries, Librarian, Curators and Reporter, whose attention to the routine duties and unremitting solicitude for the welfare of the Club, greatly contribute to its success.

The Treasurer's statement of account shows a substantial balance, principally by reason of the great expense of a Soirée not having been incurred. There is, however, a large and increasing arrear of subscriptions due, and your Committee cannot but express their regret that this should be the case, and feel sure that the Members would not, if their attention were called to it, allow the usefulness of the Club to be restricted from this cause.

Thirteen years' experience has shown that the Club, established upon the true principle of encouraging an interchange of ideas and information upon subjects in which so many are mutually interested, has still a wide and increasing field of action in this direction. It is to be hoped that as time goes on, not only will its circle of usefulness be still further enlarged, but also that those who benefit by its assistance will show their interest in its welfare, by making it the channel of their contributions to original scientific research.

TREASURER'S STATEMENT OF ACCOUNT.

Dr. June 30th, 1878.	£	s.	d.	Cr. June 30th, 1878.	£	s.	d.
To Balance in hand July 1st, 1877	71	14	10	By Printing and Stationery	27	11	0
,, Subscriptions received	214	0	0	,, Postage	9	9	9
,, Arrears of Dividends on Compounding-Fees	5	7	10	,, Attendance	10	10	0
				,, Property Purchased	28	7	4
				,, Petty Expenses	15	14	2
				,, Advertisements	0	7	6
				,, Journal	62	9	6
				,, Compounding-Fee Invested	10	0	0
				,, Donation to University College Building Fund	20	0	0
				,, Balance in hand	106	13	5
	£291	2	8		£291	2	8

MR. CRISP'S DONATION FUND ACCOUNT.

To Balance in hand July 1st, 1877	25	10	10	By Cheque Book	0	5	0
				,, Balance in hand	25	5	10
	£25	10	10		£25	10	10

Amount standing in New 3 per Cent. Annuities, £40.

We, the undersigned, having examined the above statement of Income and Expenditure, and the Vouchers relating thereto, hereby certify that the said Account is correct.

July 18th, 1878.

WM. HAINWORTH, JUN.,
H. H. DOBSON, } *Auditors.*

HONORARY MEMBERS.

Date of Election.	
Jan. 24, 1868	Arthur Mead Edwards, M.D. (*Ex-President of the American Microscopical Society: President of the Newark Scientific Association*), 120, Belleville Avenue, Newark, New Jersey, U.S.A.
Mar. 19, 1869	Rev. E. C. Bolles (*Ex-President of the Portland Society of Natural History*), Salem, Mass., U.S.A.
July 26, 1872	S. O. Lindberg, M.D., Professor of Botany, University of Helsingfors, Finland.
July 26, 1872	Prof. Hamilton L. Smith, President of Hobart College, Geneva, New York, U.S.A.
July 26, 1872	J. J. Woodward, Assist. Surgeon, U.S.A., War Department, Surgeon General's Office, Washington.
July 24, 1874	W. Sharpey, M.D., F.R.S., 50, Torrington-square, W.C.
July 23, 1875	Lionel S. Beale, M.B., F.R.S., F.R.M.S., &c., 61, Grosvenor-street, W.
Sept. 22, 1876	Frederick Kitton, Hon. F.R.M.S., &c., 10, Haymarket, Norwich.

LIST OF MEMBERS.

Date of Election.	
Sept. 24, 1869	Ackland, William, L.S.A., F.R.M.S., 416 Strand, W.C.
June 23, 1876	Addis, W., 28 Benyon-road, Southgate-road, N.
Nov. 27, 1868	Adkins, William, 268 Oxford-street, W.
Mar. 23, 1866	Allbon, W., F.R.M.S., 525 New Oxford-street, W.C.
Oct. 28, 1870	Allen, Rev. Francis H., Ditchingham, Bungay, Norfolk.
Sept. 27, 1867	Allen, John T.
Jan. 25, 1878	Allinson, John, M.R.C.S., Oxford-rd., Walthamstow.
June 23, 1876	Allison, Charles, 71 Graham-road, Dalston, E.
July 26, 1872	Alstone, John, Fortis-green, N.
Dec. 17, 1869	Ames, George Ackland, F.R.M.S., Union Club, Trafalgar-square, W.C.
Sept. 25, 1868	Andrew, Arthur R., 3 Neville-terrace, Onslow-gardens, S.W.
Dec. 22, 1865	Andrew, F. W., 3 Neville-terrace, Onslow-gardens, S.W.
July 7, 1865	Archer, J. A., 172 Strand, W.C.
Nov. 27, 1874	Armbruster, C., F.C.S., 9 Augustus-road, Hammersmith, W.
June 25, 1875	Arnold, Theodore P.
May 28, 1875	Arrowsmith, Wastell, 99 Adelaide-road, Haverstock-hill, N.W.
Nov. 24, 1876	Atkins, Walter George, Mem. Soc. Eng., 62 Fleet-street, E.C.
Dec. 22, 1865	Atkinson, John, 33 Brook-street, W.
Feb. 26, 1869	Atkinson, Wm., F.L.S., 47 Gordon-square, W.C.
Mar. 27, 1868	Aubert, Alfred, Lloyds, E.C.
July 23, 1875	Ayling, J. J., 37 Edward-st., Newington-butts, S.E.

Date of Election.	
Nov. 25, 1870	Baber, Edward Cresswell, L.R.C.P., M.R.C.S., 34 Thurloe-square, S.W.
June 26, 1874	Badcock, John, F.R.M.S., 2 Banbury-road, South Hackney, E.
Dec. 27, 1867	Bailey, John W., 75 Broke-road, Dalston, E.
April 24, 1868	Baker, Chas., F.R.M.S., 244 High Holborn, W.C.
Feb. 28, 1873	Baker, George H., M.R.C.S., 14 Mare-street, Hackney, E.
May 25, 1877	Baker, G. Levett, 15 Winslow-road, Denmark-hill.
Feb. 25, 1876	Ballard, Dr. W. R., jun., 26 Manchester-square, W.
July 28, 1876	Barnard, Hy., 1 St. Peter's-road, De Beauvoir-square, Kingsland-road, N.
Dec. 27, 1872	Barnard, Herbert, 33 Portland-place, W.
April 22, 1870	Barnes, Chas. Barritt, 4 Egremont-villas, White Horse-lane, South Norwood, S.E.
Nov. 23, 1866	Barnes, Captain E., Bridlington-quay, Yorkshire.
Aug. 28, 1874	Barnett, E. W., The Larches, Penge-lane, Sydenham, S.E.
Sept. 27, 1872	Bartlett, Edward, jun., L.D.S., M.R.C.S.E., 40 Elgin-road, St. Peter's-park, W.
June 23, 1871	Bartlett, Wm. P., 41 Gloucester-place, Hyde-park, W.
Oct. 26, 1877	Basevi, Col. G. H., Elm Lodge, Prestbury, Cheltenham.
Dec. 28, 1877	Batchelor, J. A., 10 Loughborough-park-road, Brixton, S.E.
May 22, 1874	Bate, George Paddock, M.D., F.R.M.S., 412 Bethnal Green-road, E.
July 26, 1878	Battersby, John, 61 Queen's-road, St. John's-wood, N.W.
Nov. 26, 1875	Bayfield, Chas. Moulden, 2 Leamington-road-villas, Westbourne-park, W.
Mar. 27, 1874	Beach, Richard J., 59 Ashburton-grove, Lower Holloway, N.
Jan. 25, 1878	Beaman, Geo. Hulme, 60 Fonthill-road, Finsbury-park, N.
May 28, 1869	Bean, Charles E., Brooklyn-house, Goldhawk-road, Shepherd's-bush, W.
Nov. 26, 1875	Beaulah, John, Bracken-hill, Brigg.

Date of Election.	
May 24, 1878	Beddard, Frank E., New College, Oxford.
May 26, 1871	Bedwell, Fras. Alfred, M.A. Cantab., F.R.M.S., Bridlington, Hull.
May 24, 1872	Bennett, W. H., Scientific Club, 7 Savile-row, W.
Mar. 24, 1871	Bentley, Algernon Royds, 36 Portland-place, W.
Dec. 27, 1867	Bentley, C. S., F.R.M.S., Hazelville-villa, Sunnyside-road, Hornsey-rise, N.
May 22, 1868	Berney, John, F.R.M.S., 61 North-end, Croydon.
Oct. 23, 1868	Bevington, W. A., F.R.M.S., 80 Avondale-sq., S.E.
June 24, 1870	Birch, A. E., 47, Halliford-street, Islington, N.
July 28, 1871	Bishop, Wm., 4 Whitley-villas, Caledonian-rd., N.
Feb. 23, 1866	Blake, T., 6 Charlotte-terrace, Brook-green, Hammersmith, W.
Mar. 19, 1869	Blankley, Frederick, F.R.M.S., 15 Belitha-villas, Barnsbury, N.
July 27, 1877	Blenkinsop, Benj., Sec. Hand-in-Hand Insurance Office, New Bridge-street, Blackfriars, E.C.
May 26, 1876	Blundell, Joseph, St. George's Club, 2 Savile-row, W.
Jan. 25, 1878	Bogue, David, F.R.M.S., 192 Piccadilly, W.
Oct. 24, 1873	Bolton, Major Frank, 21 Victoria-mansions, S.W.
Jan. 22, 1875	Bolton, Thos., F.R.M.S., 17 Ann-st., Birmingham.
April 22, 1870	Bossy, Alfred Horsley, Walton-lodge, 118 Stoke Newington-road, N.
Jan. 28, 1876	Bowcher, W., 6 Brownswood-villas, Stroud Green-road, N.
May 22, 1874	Box, Edward Gaspar.
June 26, 1874	Brady, Henry, 96 Palace-gardens-terrace, W.
Oct. 27, 1865	Braithwaite, R., M.D., M.R.C.S.E., F.L.S., F.R.M.S., The Ferns, 303 Clapham-road, S.W.
May 25, 1877	Bramhall, Rev. John, R.D., Terrington St. John's, near Lynn, Norfolk.
June 28, 1878	Brewster, W., Middleton Rectory, Manchester.
May 26, 1876	Brigstock, John Wm., 4 Comberton-road, Upper Clapton, E.
May 27, 1870	Brown, George Dransfield, M.R.C.S., Henley-villa, Uxbridge-road, Ealing, W.
May 22, 1868	Brown, W. J., 4 Marlbro'-terrace, Maple-road, Penge, S.E.

Date of Election.	
May 26, 1871	Browne, George, 45 Victoria road, N.W.
May 28, 1875	Browne, J. W., Frascati, Mason's-hill, Bromley, Kent.
Feb. 27, 1872	Browne, Rev. Thomas Henry, F.R.M.S., F.G.S., M.E.S., High Wycombe, Bucks.
Jan. 26, 1877	Buffham, T. Hughes, Clarence-villas, Clarendon-road, Walthamstow.
Sept. 27, 1872	Bugby, Wm., 3 Wilton-villas, Uxbridge-road, W.
May 22, 1874	Burgess, John James, 1 Copthall-chambers, E.C.
Sept. 27, 1872	Bush, Wm., Hanworth-house, Hanworth.
Aug. 24, 1877	Buxton, A. St. Clair, M.R.C.S., L.R.C.P., L.M., 17 Stowe-road, Shepherd's-bush, W.
June 14, 1865	Bywater, Witham M., F.R.M.S., 5 Hanover-square, W.
Sept. 22, 1876	Canton, Fredk., L.R.C.P., M.R.C.S., &c., 17 Great Marlborough-street, Regent-street, W.
Dec. 17, 1875	Caplatzi, A., 1 North-crescent, Bedford-square, W.C.
May 25, 1877	Carr, George, 4 Bread-street, Cheapside, E.C.
May 22, 1874	Carruthers, Herbert.
May 26, 1871	Catchpole, Robert, 3 Beaconsfield-terrace, Godolphin-road, Shepherd's-bush, W.
July 27, 1877	Chandler, Chas. F., 65 Lupus-street, S.W.
Oct. 22, 1875	Cheshire, F., Avenue-house, Acton, W.
Nov. 27, 1874	Chippindale, Geo., 21 Upper Baker-street, N.W.
Mar. 24, 1876	Clarkson, A., 49 Southampton-street, Pentonville-road, N.
May 22, 1874	Clayton, James, 67 Barnsbury-road, N.
May 22, 1868	Cocks, W. G., 36 Gayhurst-road, Dalston, E.
Sept. 22, 1876	Cole, Arthur C., St. Domingo-house, Oxford-gardens, Notting-hill, W.
Nov. 27, 1874	Cole, B. G., Ivy-cottage, Hermon-hill, Wanstead, Essex.
April 24, 1874	Cole, Wm., M.E.S., Ivy-cottage, Hermon-hill, Wanstead, Essex.
May 23, 1873	Coles, Alfred K., F.R.M.S., Stamford-hill, N.
Jan. 25, 1867	Coles, Ferdinand, F.L.S., 341 Amhurst-road, Stoke Newington, N.

Date of Election.	
April 23, 1869	Collings, Thomas P., Surrey-chambers, 172 Strand, W.C.
July 7, 1865	Collins, C., F.R.M.S., 157 Great Portland-street, W.
Mar. 24, 1876	Colsell, Geo. Dannett, 5 Austin-friars, E.C.
Feb. 23, 1872	Colvin, Alexander, Beaconside, Penrith, Cumberland.
Sept. 27, 1872	Connolly, Charles T., L.S.A., 3 Church-hill-villas, Wood-green, N.
June 14, 1865	Cooke, M. C., M.A., LL.D., A.L.S. (*Hon. Sec. for Foreign Correspondence*), 2 Grosvenor-villas, Junction-road, Upper Holloway, N.
May 28, 1875	Cooper, Chas., Jesmond-cottage, Walham-green, S.W.
Feb. 22, 1867	Cooper, Frank W., L.R.C.S. Edin., Leytonstone, E.
June 27, 1873	Corbett, Alfred L., 103 Fentiman-road, Clapham-road, S.W.
May 28, 1869	Cottam, Arthur, F.R.A.S., Office of Woods, Whitehall-place, S.W.
Jan. 28, 1876	Cotton, Thos., M.D., 214 Seven-sisters'-road, N.
July 26, 1872	Cowan, Thos. Wm., F.G.S., F.R.M.S., Hawthorn-house, Horsham, Sussex.
May 25, 1877	Coxhead, Albert C., 47 Russell-square, W.C.
Aug. 28, 1868	Crisp, Frank, LL.B., B.A. Lond., F.R.M.S., 5 Lansdowne-road, Notting-hill, W.
Dec. 23, 1870	Crisp, John S., F.R.M.S., 62 Camberwell-rd., S.E.
July 26, 1878	Crockford, Wm., 2 St. Peter's-road, Mile End, E.
Aug. 24, 1877	Croft, R. C., M.D., 204 Camden-road, N.W.
Feb. 23, 1877	Crofton, Edward, M.A. Oxon., F.R.M.S., 45 West Cromwell-road, South Kensington, S.W.
Feb. 27, 1868	Crook, Thomas, F.R.M.S., care of Mr. T. Curties, 244 High Holborn, W.C.
Sept. 28, 1866	Crouch, Henry, F.R.M.S., 66 Barbican, E.C.
June 22, 1877	Cunliffe, P.G., The Elms, Handforth, Cheshire.
Nov. 26, 1875	Cunningham, Francis Bertram, 8 Durham-terrace, Westbourne-park, W.
May 25, 1866	Curties, T., F.R.M.S., 244 High Holborn, W.C.
Jan. 22, 1875	Dadswell, Edward, 42 Barrington-road, Stockwell, S.W.
Jan. 27, 1872	Daintrey, George, Terminus-chambers, Eastbourne.

Date of Election.	
Nov. 23, 1877	Dallas, Wm. S., F.L.S., &c., The Geological Society, Burlington House.
Mar. 22, 1878	Darby, The Ven. Archdeacon, St. Bridget's Rectory, Chester.
Mar. 22, 1878	Darke, Edward, 2 Brecknock-crescent, Camden-road, N.W.
June 25, 1868	Darnley, D. Rowland, Ealing Dean, W.
Oct. 24, 1873	Dashwood, Horace, 192 St. Paul's-road, Canonbury, N.
July 23, 1871	D'Aubney, Thos., Shepherdess-walk, Hoxton, N.
May 23, 1873	Davey, Robert F., War Office, Pall-mall, S.W.
Oct. 22, 1869	Davis, Henry, 19, Warwick-street, Leamington.
May 28, 1875	Dean, Arthur, 11 Caxton-street, Addington-road, Bow, E.
Feb. 23, 1877	Death, James, Jun., Cheshunt, Herts.
May 28, 1875	Defriez, Joseph George, M.R.C.S., L.S.A., 173 Bethnal-green-road, E.
Feb. 23, 1877	Delferier, Wm. Adrian, 15 Penywern-road, South Kensington, S.W.
Nov. 24, 1876	Despointes, Francis, 16 St. George's-square, Regent's-park-road, N.W.
June 26, 1868	Dickens, Charles, Latimer-house, Hadley, Middlesex.
Jan. 28, 1876	Dilnott, Geo., Hayling, Havant, Hants.
Jan. 23, 1874	Doble, Edmund Mohun, 12 Mount Ararat-villas, Richmond, Surrey.
Nov. 24, 1865	Dobson, H. H., F.R.M.S., Holmesdale, Grange-Park, Ealing.
July 26, 1872	Doggett, Fredk. Ernest, Reid's Brewery, Liquor-pond-street, E.C.
Nov. 27, 1868	Douglas, Rev. R. C., Manaton-rectory, Moreton-hampstead, Exeter.
Jan. 28, 1870	Dowson, Edward, M.D., M.R.C.S., F.R.M.S., 117 Park-street, Grosvenor-square, W.
April 27, 1877	Draper, George, 25 Mount-pleasant, Lewisham, S.E.
July 28, 1871	Drew, G. C., Milton-house, Cassland-road, South Hackney, E.
Aug. 26, 1872	Dudgeon, R. E., M.D., 53 Montagu-square, W.

Date of Election.	
Oct. 25, 1872	Dunning, Chas. G., 22 Oseny-crescent, Camden-road, N.W.
Sept. 22, 1865	Durham, Arthur E., F.R.C.S., F.L.S., F.R.M.S., &c., 82 Brook-street, Grosvenor-square, W.
Sept. 25, 1868	Eddy, James Ray, F.R.M.S., F.G.S., The Grange, Carleton, Skipton, Yorkshire.
June 28, 1867	Edmonds, R., 178 Burrage-road, Plumstead, S.E.
May 26, 1876	Emery, Charles (*Hon. Curator*), 2 Sheen-villas, Rectory-road, Hornsey, N.
May 26, 1871	Enock, Fredk., 30 Russell-road, Seven Sisters-Road, N.
June 26, 1874	Fardon, Edward Ashby, 80 Cambridge-street, Pimlico, S.W.
Dec. 17, 1875	Farries, Thomas, F.C.S., 7 New Basinghall-street, E.C.
July 25, 1873	Fase, Rev. Henry J.
June 25, 1875	Faulkner, Hy., jun., Fernwood, Roehampton-park, S.W.
Jan. 28, 1876	Faulkner, John, Mornington-crescent, N.W.
July 26, 1867	Fitch, Frederick, F.R.G.S., F.R.M.S., Hadleigh-house, Highbury New-park, N.
Aug. 4, 1865	Foster, Peter Le Neve, M.A. Cantab., Society of Arts, Adelphi, W.C.
Mar. 24, 1871	Foulerton, J., M.D., Scientific Club, 7 Savile-row, W.
July 26, 1878	Fowke, Francis, F.R.M.S., Thatched-house Club, St. James's Street, S.W.
Dec. 28, 1866	Fox, C. J., F.R.M.S., 26 South Molton-street, Oxford-street, W.
Nov. 26, 1875	Freckelton, Rev. T. W., F.R.M.S., 28A Lonsdale-square, Islington, N.
June 23, 1871	Freeman, Henry E., 1 Templeton-road, Finsbury-park, N.
Feb. 26, 1869	Fricker, C. J., 4 Westow-hill-terrace, Upper Norwood, S.E.
May 22, 1868	Fryer, Geo. H., 82 Belsize-road, N.W.
Oct. 26, 1868	Furlonge, W. H., Coed Mawr-house, Holywell, Flintshire.

Date of Election.	
Mar. 19, 1869	Gann, James W., 171 Fenchurch-street, E.C.
Mar. 25, 1870	Garden, Robert Spring, 42 Carlton-hill, St. John's-wood, N.W.
May 25, 1866	Gardiner, G., F.M.S., 23 St. Paul's-road, N.W.
Feb. 26, 1875	Gardner, Edmund, 454 Strand, W.C.
July 27, 1877	Gardner, J. H., A.K.C., Royal Polytechnic Institution, Regent-street, W.
April 24, 1868	Garnham, John, F.R.M.S., 123 Bunhill-row, E.C.
July 7, 1865	Gay, F. W., F.R.M.S. (*Hon. Treasurer*), 113 High Holborn, W.C.
Jan. 28, 1870	Gellatly, Peter, Loughton, Essex.
July 26, 1867	George, Edward, F.R.M.S., 12 Derby-villas, Forest-hill, S.E.
April 26, 1878	Gibbins, G. W., 1 Hermes-hill-terrace, Pentonville, N.
July 22, 1870	Gibson, Joseph F., F.R.M.S., 9 Saltoun-road, Brixton, S.W.
June 14, 1865	Gibson, W., 3 Bridge-street, Westminster, S.W.
April 27, 1877	Gilbertson, Henry, Hertford.
Oct. 27, 1876	Gilburt, W. H., 42 Malmesbury-road, Bow, E.
June 27, 1873	Glasspoole, Hampden G., 34 Bernard-st., Russell-square, W.C.
Feb. 25, 1876	Godwin, John, 219 Brompton-road, S.W.
Nov. 22, 1872	Goodchild, J. E., Prospect-hill-lodge, Walthamstow, E.
Aug. 23, 1872	Goode, A., Whitehall-lane, Woodford, Essex.
April 26, 1872	Goodinge, James Wallinger, F.R.G.S., F.R.M.S., 18 Aldersgate-street, E.C.
Nov. 23, 1877	Goodwin, Wm., 93 Birkbeck-road, Hornsey-rise, N.
Mar. 27, 1866	Gray, S. Octavus, Bank of England, E.C.
Dec. 22, 1865	Gray, W. J., M.D., F.R.M.S., 41 Queen Anne-street, Cavendish-square, W.
Nov. 27, 1874	Grayling, J. Francis.
May 22, 1874	Green, G., 6 Helmet-row, St. Luke's, E.C.
Jan. 28, 1870	Green, Nathaniel E., F.R.A.S., 3 Circus-road, St. John's-wood, N.W.
Oct. 23, 1868	Greenish, T., F.R.M.S., 20 New-street, Dorset-square, N.W.
Oct. 23, 1868	Gregory, Henry R., 38 Welbeck-street, W.

Date of Election.	
May 23, 1873	Gregory, William, 406 Strand, W.C.
May 22, 1874	Grey, Ernest, 290 Essex-road, Islington, N.
June 26, 1874	Gritton, John Hall.
June 26, 1874	Gritton, Joseph.
July 24, 1868	Groves, J. W., 55 Russell-square, W.C.
July 24, 1868	Grubbe, E. W., C.E., 49 Queen's-gardens, Hyde-park, W.
Jan. 27, 1871	Guimaraens, Augustus de Souza, F.R.M.S., 120 Ossulton-street, Euston-square, N.W.
Aug. 24, 1877	Habirshaw, Fredk., F.R.M.S., 6 West 48th Street, New York, U.S.A.
Aug. 24, 1877	Habirshaw, John, M.D., F.R.M.S., 6 West 48th Street, New York, U.S.A.
Jan. 23, 1874	Hadland, J. H., 11 King William-street, E.C.
Sept. 28, 1877	Hagger, John, Repton School, Burton-on-Trent.
June 14, 1865	Hailes, Henry F. (*Hon. Curator*), 7 Haringay-road, Hornsey, N.
Aug. 26, 1870	Hailstone, Robert H., 57 Adelaide-road, N.W.
Feb. 23, 1867	Hainworth, W., jun., Clare-villa, Cricketfield-road, Lower Clapton, E.
July 28, 1876	Halford, Edwd., 18 Leinster-square, Bayswater, W.
May 25, 1877	Hall, George W. L. Marshall, 1 Cresswell-park, Blackheath, S.E.
July 23, 1875	Hallett, Marmaduke J., 1 Hanover-place, Earlham-road, Norwich.
Dec. 28, 1866	Hallett, R. J., The Gables, Child's-hill, Hendon.
Nov. 26, 1875	Halley, Alex. Hay, 7 Elgin-road, Kensington-park, W.
Feb. 22, 1869	Hammond, A., 4 Neptune-terrace, Marine-town, Sheerness.
Jan. 23, 1874	Hardy, James Daniel, 73 Clarence-road, Clapton, E.
Sept. 28, 1866	Harkness, W., F.R.M.S., Laboratory, Somerset-house, W.C.
June 23, 1871	Harris, Edward, F.R.M.S., Rydal-villa, Langton-grove, Upper Sydenham, S.E.
Jan. 25, 1878	Harrison, D. H., Argyll-villas, Mattock-lane, Ealing, W.
April 23, 1875	Harrison, James, 22 Treherne-road, North Brixton, S.W.

Date of Election.	
July 26, 1872	Harrod, John, Mark-lane-square, E.C.
Nov. 26, 1869	Hart, Edward, Highbury New-park, N.
Jan. 26, 1877	Harvey, G., 45 High-street, Kensington, W.
Nov. 24, 1871	Hawker, Charles, M.D., 2 Albion-terrace, White-horse-lane, Stepney, E.
June 24, 1870	Hawkins, S. J., 27 Lichfield-grove, Finchley, N.
June 28, 1867	Hawksley, Thos. P., 97 Adelaide-road, N.W.
Oct. 23, 1874	Haydon, W. F.
Sept. 28, 1877	Headley, Robt., F.R.G.S., 20 De Beauvoir-square, Islington, N.
Aug. 23, 1872	Hembry, F. W., 7 St. John's-villas, Overton-road, Brixton, S.W.
Aug. 26, 1870	Hennell, Col. S., F.R.M.S., Ventnor-villa, Ventnor, Isle of Wight.
June 26, 1868	Henry, A. H., 49 Queen's-gardens, Hyde-park, W.
June 26, 1874	Hewitt, W. W., F.R.M.S., 5 Torriano-gardens, Camden-road, N.W.
May 22, 1868	Hicks, J. J., 8 Hatton-garden, E.C.
June 22, 1877	Hill, Rd. W., 41 Lothbury, E.C.
Sept. 24, 1869	Hilton, T. D., M.D., Upper Deal, Deal, Kent.
Sept. 28, 1866	Hind, F. H. P., Bartholomew-house, Bartholomew-lane, E.C.
May 22, 1874	Hind, George, 244 High Holborn, W.C.
July 26, 1872	Hinton, Ernest, 12 Vorley-road, Junction-road, Upper Holloway, N.
Aug. 26, 1870	Hirst, John, jun., F.R.M.S., Dobcross, near Manchester.
Feb. 26, 1875	Holford, Chr., Bounty-office, Dean's-yard, Westminster, S.W.
April 26, 1867	Hooton, C., Sunningdale-house, Bickerton-road, Upper Holloway, N.
May 22, 1868	Hopkinson, John, F.L.S., F.R.M.S., F.G.S., Wansford-house, Watford.
April 28, 1876	Horn, Wm. E., A.I.C.E., 10 Vincent-square, Westminster, S.W.
Oct. 26, 1866	Horncastle, H., Whitemoor-house, near Ollerton, Notts.
June 25, 1869	Houghton, W., Hoe-street, Walthamstow, E.
May 22, 1874	Hovenden, C. W., F.R.M.S., 95 City-road, E.C.

Date of Election.	
April 26, 1867	Hovenden, F., F.R.M.S., Glenlea, Thurlow-park-road, Dulwich, S.E.
June 23, 1876	How, Wm. Samuel, 145 Great Portland-street, W.
Oct. 27, 1876	Howard, D., 60 Belsize-park, N.W.
Jan. 22, 1875	Howard, F. W., The Grove, Teddington.
Feb. 25, 1870	Hudleston, W. H., J.P., F.G.S., 23 Cheyne-walk, S.W.
Jan. 26, 1872	Hudson, Robert, F.R.S., F.R.M.S., &c., Clapham-common, S.W.
Dec. 28, 1866	Hunt, W. H. B., F.R.M.S., 23 Eversholt-street, Oakley-square, N.W.
Oct. 22, 1875	Hunter, John, 5 Eton-rise, Ealing, W.
Dec. 22, 1876	Hunter, J. J., 5 Eton-rise, Ealing, W.
July 25, 1873	Hurst, John Thomas, Royal Engineer Office, Portsmouth.
Nov. 25, 1870	Hutton, Rev. Wyndham M., Hungarton Vicarage, Leicester.
June 28, 1878	HUXLEY, Prof. T. H., F.R.S., &c. (*President*), Science Schools, South Kensington.
May 24, 1867	Ingpen, J. E., F.R.M.S. (*Hon. Secretary*), 7 The Hill, Putney, S.W.
Aug. 22, 1873	Israel, S., 1 The Crescent, America-square, E.C.
Dec. 17, 1869	Jackson, B.D., F.R.M.S., 30 Stockwell-road, S.W.
Dec. 17, 1875	Jackson, C. L., F.Z.S., F.R.M.S., 11 Hesketh-street, Southport, Lancashire.
July 24, 1868	Jackson, F. R., Culver-cottage, Slindon, Arundel, Sussex.
Feb. 22, 1878	James, Robt. M. C., Fennymere, Castlebar, Ealing.
June 14, 1865	Jaques, Edward, B.A., F.R.M.S., Office of Woods, Whitehall-place, S.W.
Feb. 28, 1873	Jenkins, J. W., 1 St. John's-hill, Wandsworth, S.W.
July 24, 1868	Jennings, Rev. Nathaniel, M.A., F.R.A.S., 1 Grove-terrace, Highgate-road, N.W.
Jan. 25, 1867	Johnson, John A., 15 Wellington-road, Stoke Newington, N.
Feb. 24, 1871	Johnson, M. Hawkins, F.R.M.S., F.G.S., 379 Euston-road, N.W.

Date of Election.	
June 23, 1876	Johnson, Tom Richard, 364 Camden-road, N.
Feb. 23, 1877	Johnston, J. M. C., Tudor-house, 203 Grove-lane, Camberwell, S.E.
Mar. 24, 1871	Johnstone, James, jun., Stanhope-lodge, Bideford.
Oct. 25, 1872	Jones, E. W., F.R.A.S., F.R.M.S., 53 Cowley-road, North Brixton, S.W.
Feb. 28, 1873	Jones, Geo. J., 38 St. Thomas-street, Lymington, Hants.
June 25, 1875	Jones, J. Birdsall, F.R.M.S., care of W. R. Jones, Esq., Athenæum, Liverpool.
Nov. 25, 1870	Jones, Lieut.-Col. Lewis, Ambarrow-house, Sandhurst, Wokingham.
May 23, 1873	Jones, Captain Loftus F., United Service Club, Pall Mall, S.W.
June 23, 1876	Jones, Thomas Edwd., 46 Park-street, Stoke Newington, N.
May 22, 1874	Jones, W. W., 14 Lancaster-street, Lancaster-gate, Hyde-park, W.
May 23, 1873	Karop, Geo. C., Middlesex-hospital, W.
Mar. 23, 1877	Keene, John H., The Cottage, Bishopsgate, near Staines.
Aug. 23, 1867	Kiddle, Edward, The War Office, Pall Mall, S.W.
Mar. 19, 1869	Kilsby, Thomas W., 4 Brompton-villas, Edmonton.
June 23, 1876	Kindon, Chas. J., 30 Overton-road, Brixton, S.W.
July 7, 1865	King, G. H., Sea-horse-house, 165 and 190 Great Portland-street, W.
July 22, 1870	King, Henry, 65 Myddleton-square, E.C.
Dec. 23, 1870	King, Robert, F.R.M.S., Fern-house, Upper Clapton, E.
May 24, 1878	King, Wm. Talbot, M.D., M.R.C.S., 74 Victoria-park-road, South Hackney.
April 26, 1867	Kirk, Joseph, 11 Blossom-st., Norton Folgate, E.
Nov. 27, 1874	Kirkman, Rev. Joshua, Thurlow-road, South Hampstead, N.W.
Feb. 28, 1873	Kitsell, Francis J., 7 John's-terrace, Latymer-road, W.
Mar. 23, 1877	Kluht, Hy. John, 16 Bishop's-road, W.

Date of Election.	
May 25, 1877	Knaggs, Hy. Valentine, 189 Camden-road, N.W.
Oct. 24, 1873	Knight, John Mackenzie, 2 Lansdowne-terrace, Bow-road, E.
Nov. 25, 1870	Ladd, Wm., F.R.A.S., F.R.M.S., 12 Beak-street, Regent-street, W.
Nov. 23, 1866	Lambert, W., 4 New Basinghall-street, E.C.
Mar. 22, 1867	Lancaster, Thos., Bownham-house, Stroud, Gloucestershire.
May 25, 1877	Lane-Fox, Hon. Sackville F. H., 22 Camden-cottages, Camden-road, N.W.
Dec. 28, 1866	Langrish, H., 250 Pentonville-road, N.
May 28, 1875	Larkin, John, 24 Charterhouse-square, E.C.
May 28, 1875	Laws, Joseph C., 41 St. John's-park, Upper Holloway, N.
June 25, 1869	Layton, Charles E., 12 Upper Hornsey-rise, N.
Aug. 28, 1868	Leaf, C. J., F.L.S., F.R.M.S., &c. (*President of the Old Change Microscopical Society*), Old Change, E.C.
Mar. 19, 1869	Lee, Henry, F.L.S., F.R.M.S., &c. (*Vice-President*), The Waldrons, Croydon.
May 27, 1874	Leefe, Frederick Ewbank, 289 Goswell-road, E.C.
June 23, 1876	Leeson, Herbert Seymour, 4 Old-buildings, Lincoln's-inn, W.C.
Oct. 25, 1867	Leifchild, J. R., M.A., 21 St. Lawrence-road, Notting-hill, W.
Sept. 22, 1865	Leighton, W. H., 2 Merton-place, Chiswick, W.
July 25, 1873	Le Pelley, C., 17 Underwood-street, Shepherdess-walk, Hoxton, N.
April 27, 1866	Lewis, R. T., F.R.M.S. (*Hon. Reporter*), 1 Lowndes-terrace, Knightsbridge, S.W.
June 26, 1868	Lindley, W., jun., Kidbrook-terrace, Blackheath, S.E.
Jan. 25, 1878	Lindsay, H. B., 13 Charles-street, Berkeley-square, W.
May 26, 1871	Locke, John, 16 Georgiana-street, Camden-town, N.W.
April 23, 1869	Long, Henry, 90 High-street, Croydon.
Nov. 24, 1866	Lovibond, J. W., F.R.M.S., St. Anne-street, Salisbury.

Date of Election.	
Sept. 22, 1865	Lovick, T., Board of Works, Spring-garden, S.W.
Dec. 18, 1868	Lowne, B. Thompson, F.R.C.S., F.L.S., F.Z.S., 49 Colville-gardens, Bayswater, W.
April 27, 1866	Loy, W. T., F.R.M.S., 11 Garrick-chambers, Garrick-street, W.C.
Jan. 24, 1873	McBride, Francis J.
July 26, 1878	Macdonald, John, M.D., 68 Upper Kennington-lane, S.E.
Nov. 23, 1866	McIntire, S.J., F.R.M.S., 22 Bessborough-gardens, S.W.
Jan. 26, 1872	Mackechnie, J. Hamilton, M.D., 60 Wimpole-street, Cavendish-square, W.
June 28, 1878	Magor, John Bernard, 6 Northumberland-street, Strand, W.C.
July 26, 1874	Magor, Thomas, M.D., Myddelton-road, Hornsey, N.
May 22, 1874	Manly, Dr., Thatched House Club, St. James'-st., S.W.
Sept. 27, 1872	Manning, H. E. the Cardinal Archbishop, Archbishop's House, Westminster, S.W.
June 14, 1865	Marks, E., Beaumont-villa, Beaumont-rd., Hornsey-rise, N.
Sept. 22, 1876	Martin, W. H., 11 Markham-square, Chelsea, S.W.
Dec. 27, 1867	Martinelli, A., 106 Albany-street, N.W.
Oct. 25, 1867	Marwood, W. G. H., 50 Cornhill, E.C.
June 27, 1873	Mason, Thomas.
April 26, 1867	Matthews, G. K., St. John's-lodge, Beckenham, Kent.
Oct. 26, 1866	Matthews, John, M.D., F.R.M.S. (*Vice-President*), 30 Colebrooke-row, Islington, N.
Jan. 26, 1877	Matthews, Wavell, 12 Wigmore-street, W.
Sept. 24, 1869	Matthews, William, 374 Camden-road, N.
May 26, 1871	May, John William, F.R.M.S., Arundel-house, Percy-cross, Fulham, S.W.
Feb. 27, 1874	May, Lewis J., 371 Holloway-road, N.
Dec. 17, 1875	May, Thomas, 54 Coburg-road, Old Kent-road, S.E.
Feb. 25, 1876	May, W. R., 39, Mortimer-road, Kingsland, E.

Date of Election.	
Feb. 28, 1873	Mayhew, A. F., 167 Long-lane, Bermondsey, S.E.
Mar. 22, 1867	Meacher, John W., 10 Hillmarten-road, Camden-road, N.
May 22, 1874	Meates, Edgar A., 83 Cambridge-street, Pimlico, S.W.
May 22, 1874	Messenger, G. A., 21 Glengall-grove, Old Kent-road, S.E.
Dec. 18, 1868	Mestayer, Richard, F.L.S., F.R.M.S., 7 Buckland-crescent, Belsize-park, N.W.
July 27, 1877	Michael, Albert D., F.R.M.S., 3 & 4 Great Winchester-street, E.C.
July 7, 1865	Millett, F. W., 21 Duncan-terrace, Islington, N.
Feb. 28, 1873	Mills, Charles, 4 Stanbridge-road, Putney, S.W.
May 25, 1866	Moginie, W., F.R.M.S., 26 Litchfield-grove, Finchley, N.
Mar. 27, 1868	Moore, Daniel, M.D., Hastings-lodge, Victoria-road, Upper Norwood, S.E.
Jan. 23, 1874	Moreland, Richard, jun., M.I.C.E., F.R.M.S., 3 Old-street, St. Luke's, E.C.
July 26, 1878	Morland, Henry, Cranford, near Hounslow.
Oct. 27, 1866	Morrieson, Colonel R., F.R.M.S., Oriental Club, Hanover-square, W.
Dec. 22, 1876	Morris, J. Griffith, M.R.C.S., 135 St. Owen-street, Hereford.
Oct. 27, 1876	Morris, W. G., L.D.S., 12 White-friars, Chester.
Nov. 23, 1877	Morten, T. S., 138 Haverstock-hill, N.W.
Jan. 25, 1867	Murray, R. C., 69 Jermyn-st., St. James's, S.W.
Mar. 23, 1866	Nation, W. J., 30 King-square, Goswell-road, E.C.
Feb. 22, 1878	Needham, S. H., F.R.G.S., F.G.S., 5 Mecklenburg-street, Mecklenburg-square, W.C.
Mar. 24, 1876	Nelson, Edward M., 9 Marlborough-hill, N.W.
Mar. 24, 1871	Nelson, James, 3 Oakden-street, Kennington-road, S.E.
Nov. 23, 1877	Newth, A. H., M.D., Scientific Club, 7 Savile-row, W.
Jan. 26, 1872	Newton, Edwin Tulley, F.G.S., Geological Museum, Jermyn-street, S.W.
Jan. 23, 1874	Newton, Henry Edward, Woolsthorpe, The Avenue, Gipsy-hill, Norwood, S.E.

Date of Election.	
Aug. 24, 1877	Oates, Parkinson, M.D., L.S.A., M.R.C.S., 48 Lupus-street, S.W.
Dec. 22, 1876	Ogilvy, Campbell P., Sizewell-house, Leiston, Suffolk.
May 24, 1878	O'Hara, Major Richard (late Royal Artillery), West-lodge, Galway.
Feb. 25, 1876	Ongley, H. H.
June 22, 1877	Oswin, Fred., F.S.A., 10 Gower-street, W.C.
Dec. 27, 1867	Oxley, F., 8 Crosby-square, Bishopsgate, E.C.
May 22, 1874	Palmer, Thomas, B.S., F.R.M.S., Holme Lee, Lower Camden, Chislehurst, Kent.
July 27, 1873	Parker, William, Whitehall Club, S.W.
Oct. 27, 1871	Parsons, Fred. Anthony, 90 Leadenhall-street, E.C.
Dec. 28, 1877	Partridge, Thos., M.D., Stroud, Gloucestershire.
April 23, 1875	Peal, Charles Nathaniel, Westbourne-lodge, Castlebar-hill, Ealing, W.
May 22, 1874	Pearce, George Alonzo Creech, B.A., M.B., B.C.N., Priory-chambers, Crutched-friars, E.C.
May 24, 1867	Pearce, George, Villa Helvetia, Tufnell-park, N.
Feb. 23, 1872	Pearce, W. E. Grindley, L.R.C.P., 24 Bessborough-gardens, S.W.
April 27, 1877	Pearcy, Alfred Copley, 31 Packington-street, Islington, N.
May 24, 1867	Pearson, John, 212 Edgware-road, W.
Dec. 22, 1876	Perry, George, 82 Finborough-road, South Kensington, S.W.
Oct. 27, 1865	Pickard, J. F., 1 Bloomsbury-street, W.C.
Jan. 22, 1869	Pillischer, M., F.R.M.S., 88 New Bond-street, W.
Nov. 24, 1871	Pitts, Frederick, Harvard-house, St. John's-hill, Clapham, S.W.
Sept. 28, 1877	Pocklington, Henry, F.R.M.S., Cedar-grove, Armley, Leeds.
Nov. 23, 1866	Potter, G., F.R.M.S., 42 Grove-road, Upper Holloway, N.
Jan. 25, 1878	Potts, R. A., 26 South Audley-street, W.
June 22, 1866	Powe, I., 71 George-street, Richmond, Surrey.
May 25, 1866	Powell, Hugh, F.R.M.S., 170 Euston-road, N.W.

Date of Election.	
May 26, 1876	Powell, Jas. T., 12 Dalrymple-terrace, Glenarm-road, Clapton-park, E.
Jan. 24, 1873	Powell, Jas. J., 43 Burton-road, Brixton, S.W.
July 7, 1865	Powell, Thomas, 18 Doughty-street, Mecklenburg-square, W.C.
July 24, 1874	Powell, Thomas Henry, 7 Poultry, E.C.
Jan. 22, 1875	Power, H. D'Arcy, F.L.S., 33 St. Paul's-road, Kennington, S.E.
Oct. 25, 1872	Price, W. H., 1 The Terrace, Kennington-park, S.E.
June 27, 1873	Priest, B. W., 22 Parliament-street, S.W.
July 26, 1867	Pritchett, Francis, 131 Fenchurch-street, E.C.
April 23, 1868	Quekett, Alfred J. S., 51 Warwick-road, Maida-hill, W.
April 23, 1868	Quekett, Arthur Edwin, 51 Warwick-road, Maida-hill, W.
April 23, 1868	Quekett, Rev. William, The Rectory, Warrington.
Feb. 23, 1866	Quick, George E., 109 Long-lane, Bermondsey, S.E.
Oct. 26, 1866	Rabbits, W. T., Highfield, Dartmouth-park, Forest-hill, S.E.
Sept. 24, 1869	Radcliffe, J. D.
Nov. 23, 1866	Radermacher, J. J., The Pantechnicon, Motcombe-street, Belgrave-square, S.W.
June 25, 1875	Radford, W. S., M.D., F.R.M.S., Sidmouth.
Oct. 26, 1866	Ramsden, Hildebrand, M.A. Cant., F.L.S., F.R.M.S., Forest-rise, Walthamstow, E.
Aug. 28, 1868	Rance, T. G., Elmside, Bickley, Kent.
May 22, 1868	Rawles, W., 64 Kentish-town-road, N.W.
June 23, 1876	Redmayne, John T., M.R.C.S., F.R.M.S., &c., Astley-bank, Bolton, Lancashire.
June 22, 1877	Reed, John W., F.R.G.S., 27 Clarence-street, Islington, N.
June 27, 1873	Reeve, Fredk., 37 Fentiman-road, Clapham-road, S.W.
July 7, 1865	Reeves, W. W., F.R.M.S., 30 Ashburnham-grove, Greenwich, S.E.
May 22, 1874	Reid, Wm. Wardlaw, 16 Warwick-place, Peckham Rye, S.E.

Date of Election.	
May 26, 1871	Richards, Edward, F.R.M.S., 289 Camberwell New Road, S.E.
Mar. 25, 1870	Richardson, Thomas Hyde, 1 Belgrave-villas, Holmesdale-road, Selhurst, S.E.
June 25, 1869	Roberts, John H., F.R.C.S., F.R.M.S., 82 Finchley-road, St. John's-wood, N.W.
April 26, 1872	Roberts, S. Hackett, F.R.M.S., 26 King William-street, E.C.
May 22, 1868	Rogers, John, F.R.M.S., 4 Tennyson-street, Nottingham.
Oct. 26, 1866	Rogers, Thomas, F.L.S., F.R.M.S., Selmeston-house, Thurlow-park-road, West Dulwich.
Mar. 22, 1872	Rolfe, Charles Spencer, 6 Westminster-chambers, S.W.
May 22, 1868	Roper, Freeman C. S., F.L.S., F.G.S., F.R.M.S., Palgrave-house, Eastbourne, Sussex.
June 23, 1876	Roper, Hy. John, F.R.M.S., 5 Lausanne-road, Peckham, S.E.
Oct. 27, 1876	Roper, Robert, 4 Westbury-villas, Westbury-road, Upton, Stratford, E.
July 24, 1868	Rowe, James, jun., M.R.C.V.S., 65 High-street, Marylebone, W.
Oct. 26, 1866	Rowlett, John, 92 Enville-road, Walworth, S.E.
July 14, 1865	Ruffle, G. W., 131 Blackfriars-road, S.E.
July 24, 1874	Rushton, William, 61 Tufnell-park-road, Holloway, N.
Oct. 27, 1865	Russell, James, 10 High-street, Shoreditch, E.
Oct. 26, 1866	Russell, Joseph, Blenheim-house, Middle Mall, Hammersmith, S.W.
May 22, 1868	Russell, Thomas D., 21 Park-road, West Dulwich, S.E.
Feb. 22, 1867	Rutter, H. Lee, 1 St. Barnabas-villas, Lansdowne-circus, South Lambeth, S.W.
May 23, 1873	Salkeld, Lt.-Colonel Joseph C., F.R.M.S., 29 St. James's-street, S.W.
Dec. 17, 1869	Salmon, John, 24 Seymour-street, Euston-square, N.W.
Dec. 28, 1877	Sands, Chas., 5 Woburn-place, Russell-square, W.C.

Date of Election.	
May 28, 1875	Saul, Geo. William, 120 Cheapside, E.C.
May 24, 1872	Schloesser, Ernest, 9 College-hill, Cannon-street, E.C.
Feb. 26, 1875	Scofield, W. J., M.R.C.S., F.L.S., 13 South Hill Park-gardens, Hampstead, N.W.
May 24, 1872	Sequeira, H. L., M.R.C.S., 1 Jewry-street, Aldgate, E.C.
July 27, 1868	Sewell, Richard, Ashmore-house, Keston, Kent.
Oct. 22, 1869	Shaw, Wm. Forster, Mosshall-grove, Finchley, N.
Jan. 22, 1869	Sheehy, William H., M.D., 4 Claremont-square, N.
May 26, 1876	Shepheard, Thomas, F.R.M.S., 12 Bridge-street, Row, Chester.
May 26, 1871	Sigsworth, J. C., F.R.M.S., 18 Chaucer-road, Herne hill, S.E.
June 27, 1873	Simmonds, Joseph E., 13 Ann's-terrace, near Walham-green, S.W.
Aug. 23, 1867	Simmons, James J., L.D.S., 18 Burton-crescent, Euston-road, N.W.
May 26, 1876	Simpson, Edwd., 24 Grummant-road, Peckham-road, S.E.
Nov. 23, 1877	Simpson, Thos., Audley-lodge, Florence-road, Ealing, W.
Mar. 27, 1868	Simson, Thos., The Laurels, Courtyard, Eltham.
May 28, 1869	Sketchley, H. G., 72 Wilson-street, Derby.
Dec. 28, 1866	Slade, J., 100 Barnsbury-road, N.
Mar. 24, 1872	Smart, Harry, 8 The Paragon, Hackney, E.
Oct. 23, 1868	Smart, William, 27 Aldgate, E.
May 25, 1866	Smith, Alpheus (*Hon. Librarian*), 42 Choumert-road, Rye-lane, Peckham, S.E.
Oct. 26, 1877	Smith, Bernard E., Aucklands, Wandsworth-common, S.W.
Feb. 25, 1876	Smith, Edward, F.S.S., 37 Old Jewry, E.C.
Mar. 25, 1870	Smith, Francis Lys, 3 Grecian-cottages, Crown-hill, Norwood, S.E.
June 27, 1873	Smith, G. J., 5 St. Bride's-street, Ludgate-circus, E.C.
Oct. 26, 1866	Smith, H. Ambrose, 2 King William-street, E.C.
June 26, 1868	Smith, James, F.L.S., F.R.M.S., 13 Canonbury-place, Islington, N.

Date of Election.	
Dec. 23, 1870	Smith, Joseph A., Granville-lodge, Croydon-road, Penge, S.E.
May 22, 1874	Smith, Roland D., M.R.C.S.E., F.R.M.S., London Hospital, Mile End, E.
Oct. 26, 1877	Smith, Samuel, 331 Hackney-road, E.
June 24, 1870	Smith, William.
Feb. 28, 1873	Smith, W. Lepard, Southfield-house, Watford.
Aug. 23, 1872	Smith, W. Stuart, 30 Loraine-road, Holloway, N.
April 24, 1868	Snellgrove, W., 58 Cranfield-road, Wickham-park, S.E.
May 24, 1878	Southey, A., 145 Fenchurch-street, E.C.
Sept. 22, 1865	Southwell, C., 44 Princes-street, Soho, W.
May 26, 1876	Southwell, Chas. Wm., 1 Stoke Newington-green, N.
Dec. 18, 1868	Sowerby, D., 38 Albert-road, Dalston, E.
May 22, 1874	Spencer, James, F.R.M.S., South-street, Greenwich, S.E.
June 26, 1876	Spencer, John, Brook's Bank, 81 Lombard-street, E.C.
Nov. 22, 1872	Spencer, Thomas, F.C.S., F.R.M.S., 32 Euston square, N.W.
Mar. 24, 1866	Starling, Benjamin, 9 Gray's-inn-square, W.C.
Jan. 26, 1877	Steele, James W., 7 Charlemont-terrace, Cork.
Feb. 23, 1872	Stevens, C. R., 7 Ashby-road, Canonbury, N.
Aug. 24, 1866	Steward, J. H., F.R.M.S., 406 Strand, W.C.
May 23, 1873	Steward, James H. C., 406 Strand, W.C.
June 22, 1877	Stewart, Chas., M.R.C.S., F.L.S., F.R.M.S., &c. (*Vice-President*), St. Thomas' Hospital, and 25 Albert-square, Clapham, S.W.
Sept. 22, 1876	Stiles, M. H.
Mar. 19, 1869	Stokes, Frederick, 17 Milton-road, Herne-hill, S.E.
April 28, 1876	Stopher, Wm., 24 Coleman-street, E.C.
Oct. 27, 1871	Stuart, David John, 53 Ferntower-road, Highbury New-park, N.
July 7, 1865	Suffolk, W. T., F.R.M.S., 48 Treherne-road, Vassal-road, Brixton, S.E.
June 27, 1873	Suter, Edward D., Kent-lodge, Douglas-road-north, Canonbury, N.

Date of Election.	
June 24, 1870	Swain, Ernest, 90 Campden-hill-road, W.
Nov. 22, 1867	Swainston, J. T., 3 St. Mark's-square, Regent's-park, N.W.
Nov. 24, 1866	Swansborough, E., 20 John-street, Bedford-row, W.C.
Dec. 18, 1868	Swift, James, 43 University-street, W.C.
Dec. 17, 1875	Swift, Mansell, 43 University-street, W.C.
Nov. 25, 1870	Tafe, John Forwood, Fernlea, King Edward-road, Victoria-park, E.
July 27, 1877	Tanqueray, A. C., Reid's Brewery, Theobald's-road, E.C.
Sept. 28, 1877	Tarrant, Kenneth J., Litchford-house, Hatch-end, Pinner.
May 22, 1868	Tatem, J. G., Russell-street, Reading.
Jan. 23, 1874	Taylor, John Ellor, Ph.D., F.L.S., F.G.S., The Museum, Ipswich.
Dec. 22, 1865	Terry, J., 109 Borough-road, S.E.
Aug. 23, 1872	Terry, Thomas, 5 Austin-friars, E.C.
July 23, 1869	Thin, James, Ormiston-lodge, Claremont-place, Brixton-road, S.W.
May 28, 1875	Thomson, John Reid, 18 Highbury-place, N.
Feb. 24, 1871	Thornthwaite, W. H., 416 Strand, W.C.
April 27, 1877	Thorpe, George, 20 Eastcheap, E.C.
Jan. 22, 1875	Tinney, William A., Ulster-cottage, Park-village-east, N.W.
Nov. 27, 1867	Tomkins, Samuel Leith, 26 Buckland-crescent, Belsize-park, N.W.
June 23, 1871	Topping, Amos, 28 Charlotte-street, Caledonian-road, N.
July 26, 1872	Townsend, John Sumsion, F.R.M.S., Stamford-lodge, St. John's, Sevenoaks.
July 24, 1868	Tulk, John A., M.D., F.R.M.S., Burton-lodge, Staines-road, Twickenham.
July 26, 1867	Turnbull, Joseph, Laurel-house, North-hill, Highgate, N.
Aug. 24, 1877	Turner, Ernest Blaker, 46 Malmsbury-road, Bow, E.
June 25, 1869	Turner, R. D., Chafford, Tunbridge.

Date of Election.	
June 25, 1875	Turner, Sydney, 29 Ampthill-square, Hampstead-road, N.W.
May 25, 1877	Veasey, Robt. Geo., Ashchurch-lodge, Ashchurch-road, Shepherd's-bush, W.
July 27, 1866	Veitch, Harry, F.H.S., The Royal Exotic Nursery, King's-road, Chelsea, S.W.
Jan. 22, 1875	Vivian, The Hon. J. C., Selwyn-court, Richmond, Surrey.
April 24, 1874	Walker, Enoch.
May 28, 1869	Walker, Henry, F.G.S., 8 Walterton-road, St. Peter's-park, Paddington, W.
Feb. 27, 1874	Walker, John C., 14 Hilldrop-road, Camden-rd., N.
July 25, 1873	Walker, John Stringer, Warwick-road, Upper Clapton, E.
June 26, 1868	Walker, J. W., Fairfield-house, Watford.
Dec. 18, 1868	Waller, A., 11 Aberdeen-park, Highbury, N.
May 22, 1868	Waller, J. G., 68 Bolsover-street, Portland-road, W.
Oct. 26, 1877	Wallis, Geo. Hy., The Residences, South Kensington Museum, S.W.
July 24, 1874	Wallis, James, 22 Cranmer-road, Brixton-road, S.E.
Oct. 26, 1877	Walters, W., B.A. Lond., Lime-villa, Lewisham-road, Forest-hill, S.E.
Aug. 26, 1870	Warburton, Samuel, Merton-villa, New-road, Lower Tooting, S.W.
Dec. 22, 1871	Ward, Daniel, 26 Coleman-street, Woolwich, S.E.
Nov. 22, 1867	Ward, F. H., M.R.C.S., F.R.M.S., Springfield-house, near Tooting, S.W.
June 28, 1878	Ward, Richard John, Silver-street, Lincoln.
Dec. 18, 1868	Warner, Alfred, care of Mr. W. F. Stanley, 13 Railway-approach, London-bridge, S.E.
May 25, 1866	Warrington, H. R., 7 Royal Exchange, Cornhill, E.C.
Oct. 27, 1865	Watkins, C. A., 10 Greek-street, Soho, W.
Oct. 25, 1872	Watkins, J., L.C.P., 40 Store-street, Bedford-square, W.C.
Sept. 28, 1877	Watson, Thos. P., 313 High Holborn, W.C.

Date of Election.	
Dec. 28, 1877	Watson, Thos. W., 4 Pall Mall, S.W.
Dec. 28, 1866	Way, T. E., 65 Wigmore-street, W.
Oct. 26, 1877	Weatherley, Capt. H. C. S., 64 Cheapside, E.C.
July 24, 1874	Webb, C. E., Wildwood-lodge, North-end, Hampstead, N.W.
May 24, 1867	Weeks, A. W. G., 36 Gunter-grove, West Brompton, S.W.
Feb. 25, 1876	Wheeler, George, 7 St. John's-terrace, E.C.
April 23, 1869	White, Charles Frederick, F.R.M.S., 42 Windsor-road, Ealing, W.
Feb. 26, 1868	White, Francis W., 5 Gipsy-hill-villas, Gipsy-hill, S.E.
May 22, 1868	White, T. Charters, M.R.C.S., L.D.S., F.R.M.S. (*Vice-President*), 32 Belgrave-road, S.W.
July 25, 1873	White, Walter, Litcham, Norfolk.
May 23, 1873	Whitmore, John, M.D., 15 Wimpole-street, W.
June 25, 1875	Whitney, Edward Underwood, 13 Great College-street, Westminster, S.W.
July 24, 1868	Wight, James F., F.R.M.S., Grazeley, Gipsy-hill, Upper Norwood, S.E.
Mar. 24, 1871	Williams, George, 1 Devonport-road, Shepherd's-bush, W.
Nov. 23, 1877	Williams, Geo. Sawyer, 10 Clifton-villas, Maida-hill, W.
April 23, 1875	Williams, Henry, Victoria Nurseries, Upper Holloway, N.
June 23, 1876	Williams, Jas. W., New-court, St. Swithin's-lane, E.C.
Oct. 24, 1873	Williams, John R., F.R.M.S., 59 Albion-road, Stoke Newington, N.
July 28, 1871	Williams, Robert Packenham, 18 Brunswick-road, Upper Holloway, N.
Jan. 25, 1867	Willsworth, H., 3 St. John's-villas, Upper Holloway, N.
May 24, 1878	Wilmer, Horace, Chelmsford-rd., Woodford, Essex.
Mar. 24, 1876	Wilson, Chas. Joseph, 14 Highbury-crescent, N.
Feb. 22, 1867	Wilson, Frank, 110 Long-acre, W.C.
Aug. 27, 1869	Woods, W. Fell, 1 Park-hill, Forest-hill, S.E.
Jan. 28, 1876	Woollett, John, 58 Cloudesley-road, Islington, N.

Date of Election.	
Oct. 25, 1867	Worthington, Richard, Champion-park, Denmark-hill, S.E.
June 27, 1873	Wrey, George E. B., Addington-house, Addington-road, Reading.
Jan. 23, 1874	Wright, Cecil H., 27 Wardour-street, W.
Nov. 23, 1866	Wright, Edward, 89 Shepherdess-walk, E.C.
Aug. 4, 1865	Wyatt, C. C., 9 North Audley-street, W.
May 25, 1877	Yates, Francis, Rockwood, Surbiton-hill.
Jan. 25, 1878	Yates, Robert, 64 Park-street, Southwark.
Oct. 26, 1866	Yeats, Christopher, Mortlake, Surrey, S.W.

NOTICE.

Members are requested to give the Hon. Secretary early notice of any change of Residence, so as to prevent miscarriage of Journals and Circulars.

RULES.

I.—That the Quekett Microscopical Club hold its meetings at University College, Gower Street, on the fourth Friday Evening in every month, at Eight o'clock precisely, or at such other time or place as the Committee may appoint.

II.—That the business of the Club be conducted by a Committee, consisting of the President, four Vice-Presidents, the Treasurer, the Honorary Secretary, the Honorary Secretary for Foreign Correspondence, and twelve other members,—six to form a quorum. That the President, Vice-Presidents, Treasurer, Secretaries, and the four senior members of the Committee (by election) retire annually, but be eligible for re-election. That the Committee may appoint a stipendiary Assistant Secretary, who shall be subject to its direction.

III.—That at the ordinary Meeting in June, nominations be made of Candidates to fill the offices of President, Vice-Presidents, Treasurer, Honorary Secretaries, and vacancies on the Committee. That such nominations be made by resolutions duly moved and seconded, no Member being entitled to propose more than one Candidate. That the President, Vice-Presidents, Treasurer, Honorary Secretary, and Honorary Secretary for Foreign Correspondence be nominated by the Committee. That a list of all nominations made as above be printed in alphabetical order upon the ballot paper. That at the Annual General Meeting in July all the above officers be elected by ballot from the candidates named in the lists, but any member is at liberty to substitute on his ballot-paper any other name or names in lieu of those nominated for the offices of President, Vice-Presidents, Treasurer, Honorary Secretary, and Honorary Secretary for Foreign Correspondence.

IV.—That in the absence of the President and Vice-Presidents the Members present at any ordinary Meeting of the Club elect a Chairman for that evening.

V.—That every Candidate for Membership be proposed by two or more Members, who shall sign a certificate (see Appendix) in recommendation of him—one of the proposers from personal knowledge. The certificate shall be read from the chair, and the Candidate therein recommended balloted for at the following Meeting. Three black balls to exclude.

VI.—That the society include not more than twenty Honorary Members, elected by the Members by ballot upon the recommendation of the Committee.

VII.—That the Annual Subscription be Ten Shillings, payable in advance on the 1st of July, but that any Member elected in May or June be exempt from subscription until the following July. That any Member desirous of compounding for his future subscription may do so at any time by payment of the sum of Ten Pounds; all such sums to be duly invested in such manner as the Committee shall think fit. That no person be entitled to the full privileges of the Club until his subscription shall have been paid; and that any Member omitting to pay his subscription six months after the same shall have become due (two applications in writing having been made by the Treasurer) shall cease to be a Member of the Club.

VIII.—That the accounts of the Club be audited by two Members, to be appointed at the ordinary Meeting in June.

IX.—That the Annual General meeting be held on the fourth Friday in July, at which the Report of the Committee on the affairs of the Club, and the Balance Sheet duly signed by the Auditors shall be read. Printed lists of Members nominated for election as President, Vice-Presidents, Treasurer, Secretaries, and Members of the Committee having been distributed, and the Chairman having appointed two or more Members to act as Scrutineers, the Meeting shall then proceed to ballot. If from any cause these elections, or any of them, do not take place at this Meeting, they shall be made at the next ordinary Meeting of the Club.

X.—That at the ordinary Meetings the following business be transacted:—The minutes of the last Meeting shall be read and confirmed; donations to the Club since the last Meeting announced

and exhibited; ballots for new Members taken; papers read and discussed; and certificates for new Members read; after which the Meeting shall resolve itself into a conversazione.

XI.—That any Member may introduce a Visitor at any ordinary meeting, who shall enter his name with that of the Member by whom he is introduced in a book to be kept for the purpose.

XII.—That no alteration be made in these Laws, except at an Annual General Meeting, or a Special General Meeting called for that purpose; and that notice in writing of any proposed alteration be given to the Committee, and read at the ordinary Meeting at least a month previous to the Annual or Special Meeting, at which the subject of such alteration is to be considered.

APPENDIX.

Form of Proposal for Membership.

Queekett Microscopical Club.

Mr.
of
being desirous of becoming a Member of this Club, we beg to recommend him for election.

(*on my personal knowledge*).

This Certificate was read 187
The Ballot will take place 187

RULES FOR THE EXCHANGE OF SLIDES.

I. That all Slides be deposited with the Hon. Curator.

II. That not more than two similar Slides be placed in the Exchange Box at one time by any one Member.

III. That the Slides be classified by the Curator into Sections, numbered according to quality.

IV. Members to select from the class in which their Slides are placed, at the conversational meetings of the Club.

V. Members may leave the selection to the Curator, if they prefer it.

VI. Slides once exchanged cannot be exchanged again.

VII. A Register shall be kept, in which the Slides deposited shall be entered and numbered, with the date of receipt, and in which exchanges shall also be noted.

VIII.—All expenses incurred in the transmission of Slides or in correspondence respecting them, to be borne by the Member on whose account such charges may be incurred.

Parcels may be addressed—

Mr. John E. Ingpen,
7, The Hill,
Putney, S.W.
[Exchange.]

Note.—As much inconvenience frequently arises from the breakage of Slides in transmission through the Post, the following method is recommended:—Pack the Slides in a small wooden box, which can be obtained of any Optician, tie it securely with string and attach a slip of parchment to one end, sufficiently large to receive the Postage Stamps, Address, and local Post-office Stamps during transmission.

If paper be used as a wrapper to the box, the colour should be *black*.

When twelve or more Slides are sent, they should be packed in a racked box and forwarded by Railway.

MEETINGS

OF THE

QUEKETT MICROSCOPICAL CLUB,

AT

UNIVERSITY COLLEGE, GOWER STREET, LONDON.

1878.—August	9	23
September	13	27
October	11	25
November	8	22
December	13	27
1879.—January	10	24
February	14	28
March	14	28
April	*	25
May	9	23
June	13	27
July	11	25

* April 11—Good Friday, No Meeting.

The Ordinary Meetings are held on the *fourth* Friday in each month:—business commences at 8 o'clock p.m.

The Meetings on the *second* Friday in each month are for Conversation and Exhibition of Objects; from 7 to 9.30 p.m.

The Annual General Meeting will be held on July 25th, 1879, at 8 o'clock, for Election of Officers and other business.

EXCURSIONS, 1878.

March 23rd.	BARNES. To meet at Waterloo Station (Richmond Line).
April 6th.	NORTHFLEET (for SWANSCOMBE). To meet at Cannon Street Station.
April 20th.	CHISLEHURST. To meet at Charing Cross Station.
May 4th.	HOMERTON (for HACKNEY MARSHES). To meet at Broad Street Station.
May 18th.	SNARESBROOK. To meet at Liverpool Street Station.
June 1st.	ST. ALBANS. To join the Watford Club. To meet at Euston Station.
June 15th.	REDHILL JUNCTION (for NUTFIELD). To join the Croydon Club. To meet at Charing Cross Station.
June 20th.	EXCURSIONISTS' ANNUAL DINNER. Arrangements will be duly announced.
June 29th.	WEYBRIDGE. To meet at Waterloo Station (Main Line).
July 4th.	GRAVESEND, DAY EXCURSION. To meet at Fenchurch Street Station, the first Train after 10 a.m.
July 13th.	HAMPTON COURT. To meet at Waterloo Station (Main Line).
July 27th.	TORRINGTON PARK (for TOTTERIDGE), returning by Mill Hill. To meet at Moorgate Street Station.
Sept. 7th.	THAMES DITTON. To meet at Waterloo Station (Main Line).
Sept. 21st.	EDGWARE. To meet at King's Cross Station, Great Northern Railway.
Oct. 5th.	BROMLEY (for KESTON). To meet at Holborn Viaduct Station.
Oct. 19th.	GRAYS. To meet at Fenchurch Street Station.

The time of departure from Town, unless otherwise specified, will be THE FIRST TRAIN AFTER TWO O'CLOCK.

F. W. Gay,
F. Oxley,
W. W. Reeves,
T. Rogers,
J. Spencer,
} Excursion Committee.

Printed by W. Davy & Son, Gilbert-street, W.

FOURTEENTH REPORT

OF THE

QUEKETT MICROSCOPICAL CLUB,

AND

LIST OF MEMBERS.

Meeting at University College, London, on the Second and Fourth Fridays of Every Month.

LONDON.

July 1879.

(*Extract from original Prospectus, July* 1865.)

"The want of such a Club as the present has long been felt, wherein "Microscopists and Students with kindred tastes might meet at stated periods "to hold cheerful converse with each other, exhibit and exchange specimens, "read papers on topics of interest, discuss doubtful points, compare notes of "progress, and gossip over those special subjects in which they are more or "less interested: where, in fact, each member would be solicited to bring his "own individual experience, be it ever so small, and cast it into the treasury "for the general good. Such are some of the objects which the present Club "seeks to attain. In addition thereto it hopes to organize occasional Field "Excursions, at proper seasons, for the collection of living specimens; to "acquire a Library of such books of reference as will be most useful to "enquiring students; and, trusting to the proverbial liberality of Micro-"scopists, to add thereto a comprehensive Cabinet of Objects. By these and "similar means, the Quekett Microscopical Club seeks to merit the support "of all earnest men who may be devoted to such pursuits; and, by fostering "and encouraging a love for Microscopical studies, to deserve the approval "of men of science and more learned societies."

OFFICERS AND COMMITTEE.

(Elected July and Sept., 1879.)

President.

T. Spencer Cobbold, M.D., F.R.S., F.L.S., &c.

Vice-Presidents.

T. H. Huxley, LL.D., F.R.S., &c.
John Matthews, M.D., F.R.M.S.
A. D. Michael, F.L.S., F.R.M.S.
Charles Stewart, M.R.C.S., F.L.S., F.R.M.S.

Hon. Treasurer.

F. W. Gay, F.R.M.S., 113, High Holborn, W.C.

Hon. Secretaries.

H. F. Hailes, 7, Haringay Road, Hornsey, N.
J. E. Ingpen, F.R.M.S., 7, The Hill, Putney, S.W.

Hon. Secretary for Foreign Correspondence.

M. C. Cooke, M.A., LL.D., A.L.S.

Committee.

W. H. Gilburt, F.R.M.S.
F. A. Parsons.
B. W. Priest.
T. Spencer, F.C.S., F.R.M.S.
Frederick Oxley, F.R.M.S.
Ferdinand Coles, F.L.S.
Arthur Cottam, F.R.A.S.
Edward Dadswell.
J. W. Groves.
J. W. Reed, F.R.G.S.
J. C. Sigsworth, F.R.M.S.
T. C. White, M.R.C.S., &c.

Hon. Reporter.

Richard T. Lewis, F.R.M.S.

Hon. Librarian.

Alpheus Smith.

Hon. Curator.

Charles Emery.

Excursion Committee.

F. W. Gay, F.R.M.S.
Frederick Oxley, F.R.M.S.
W. W. Reeves, F.R.M.S.
T. Rogers, F.L.S., F.R.M.S.
James Spencer, F.R.M.S.

PAST PRESIDENTS.

	Elected.
EDWIN LANKESTER, M.D., F.R.S. - -	July, 1865.
ERNEST HART - - - - - - -	,, 1866.
ARTHUR E. DURHAM, F.L.S., &c. - -	,, 1867.
,, ,, ,, - - -	,, 1868.
PETER LE NEVE FOSTER, M.A. - -	,, 1869.
LIONEL S. BEALE, M.B., F.R.S., &c. -	,, 1870.
,, ,, ,, - - -	,, 1871.
ROBERT BRAITHWAITE, M.D., F.L.S., &c.	,, 1872.
,, ,, ,, - - -	,, 1873.
JOHN MATTHEWS, M.D., F.R.M.S. - -	,, 1874.
,, ,, ,, - - -	,, 1875.
HENRY LEE, F.L.S., F.G.S., F.R.M.S., F.Z.S.	,, 1876.
,, ,, ,, - - -	,, 1877.
THOS. H. HUXLEY, LL.D., F.R.S., &c. -	,, 1878.

REPORT OF THE COMMITTEE.

In accordance with custom your Committee present their Report upon the state and progress of the Club during the past year.

Your Committee announce with pleasure that the Council of University College have renewed their permission to hold our meetings here during the ensuing year. Our cordial thanks are due to them for this long-continued kindness and courtesy.

Five deaths have occurred among the members during the past year, viz.:—Mr. John T. Allen, Mr. P. Le Neve Foster, Dr. C. Hawker, The Hon. J. C. Vivian, and Mr. H. Willsworth. Among these, the death of Mr. Peter Le Neve Foster will be regretted by those of us who were associated with him. He was one of the earliest members of the Club, having joined in August 1865. He was our President from July 1869 to 1870, and rendered valuable service by his influence and advice. In later years he was unable to attend our meetings, but he always evinced a strong interest in the welfare of the Club.

Your Committee cannot forbear to mention the recent death of Dr. Tilbury Fox, who retired from the Club some years since. He also was one of our earliest members, and a Vice-President from July 1866 to 1868, during which time he took a very active part in our proceedings, especially in Dr. Cooke's "Fibre Committee."

There have been 11 resignations during the year; 37 members

have been struck off for non-payment of subscription; 71 new members have been elected, and our present number is 580.

The following communications have been made to the Club during the past year:—

1878.

August 23. "On Certain Microscopic Fungi," by Dr. M. C. Cooke.
„ „ "On the Present State of the Angular Aperture Question," by Mr. J. E. Ingpen.
Sept. 27. "On the History and Structure of Corals, by Dr. Matthews.
Oct. 25. "On the Floral Development of *Helianthus annuus*," by Mr. W. H. Gilburt.
„ „ "On the Queen Bee and her Fertilization," by Mr. John Hunter.
Nov. 22. "On an Improved Dissecting Microscope," by the President.
Dec. 27. "On the Histology and Life History of Lichens," by Mr. Charles Stewart.

1879.

Jan. 24. "On the Urticating Threads of *Actinia parasitica*," by Mr. F. A. Bedwell.
„ „ "On a New Method of Preparing a Dissected Model of an Insect's Brain," by Mr. E. T. Newton.
Feb. 28. "On the Rotifers, by Dark Field Illumination," by Dr. C. T. Hudson.
„ „ "On the Micro-megascope," by Dr. Matthews.
March 28. "On the Dual-lichen Hypothesis," by Dr. M. C. Cooke.
April 25. "On a Method of Resolving the Finest-lined Diatom Tests," by Mr. Adolf Schulze.
„ „ "On Some Peculiarities in the Reproductive System of some of the Acarina," by Mr. A. D. Michael.
„ „ "On a Successful Method of Examining the Anatomy of *Actinia mesembryanthemum*," by Mr. F. A. Bedwell.
May 23. "Note on the Micro-megascope," by Mr. Ingpen.
„ „ "On a New Microscopical Turn-table," by Mr. C. Spencer Rolfe.
„ „ "On Stained Sections of Animal Tissues, and how to make them," by Mr. J. W. Groves.
June 27. "On *Drosera rotundifolia*," by Mr. T. C. White.
„ „ "On a General Law of Aplanatic Systems," by Dr. E. Abbe, of Jena.

Besides sundry short notes on various subjects.

The following additions have been made to the Library:—

	PRESENTED BY
Edgeworth (M. P.), On Pollen	*Mr. W. M. Bywater.*
Lowne (B. T.), On the Eyes of Insects	*The Author.*
Huxley (T. H.), Manual of the Anatomy of Vertebrated Animals	*Quekett Dinner Committee.*
Gegenbauer (C.), Elements of Comparative Anatomy	„ „
Westwood (J. V.), Introduction to the Classification of Insects	„ „
Nicholson (H. A.), Manual of Zoology, Fifth Edition	„ „
Hincks (T.), History of the British Hydroid Zoophytes	„ „
Cobbold (T. S.), Parasites; a Treatise on the Entozoa of Man and Animals	*Mr. T. Charters White.*
Van Heurck (H.), Le Microscope	*Mr. Frank Crisp.*
Sundry Papers on Sponges	*Dr. M. C. Cooke.*
Popular Science Review	*The Publisher.*
Hardwicke's Science Gossip	„
Journal of the Royal Microscopical Society	*The Society.*
Buckton (G. B.), Monograph of the British Aphides. Vol. II. Ray Society	*By Subscription.*
Brady (G. S.), Monograph of the British Copepoda. Ray Society	„
American Naturalist	*In Exchange.*
American Quarterly Microscopical Journal	„
American Journal of Microscopy	„
Midland Naturalist	„
Quarterly Journal of Microscopical Science	*Purchased.*
Annals and Magazine of Natural History	„
Grevillea	„

Sundry Proceedings of Scientific Societies and Pamphlets.

The revision of the Cabinet by the Sub-Committee and Hon. Curators has been completed; and a new catalogue has been prepared by Mr. H. F. Hailes, and circulated amongst the members. Those who are working out subjects of interest may

render good service by contributing specimens of objects in those sections which are still but scantily represented. The following additions have been made during the past year:—

Mr. J. Cocken	74	Slides.
„ A. C. Cole	26	„
„ H. G. Glasspoole	2	„
„ H. C. Morland	1	„
„ F. Kitton	1	„
„ A. D. Michael	14	„
„ S. C. Peticolas, per Mr. W. A. Allen	4	„
„ W. Teasdale	6	„
„ F. H. Ward	22	„
Total	150	„

Eight portraits have been added to the Album.

Your Committee are glad to be able to announce that our relations with other Microscopical and Natural History Societies continue to be of a friendly and satisfactory character. In particular they wish to refer to the honour that has been conferred upon the Club by the Royal Microscopical Society in constituting our Presidents *ex officio* Fellows. An interchange of Journals and Proceedings also takes place with several Provincial and Foreign Societies, and is productive of beneficial results.

The Excursions during the past year have for the most part been well attended and productive, and the opportunities thus afforded for meeting members of local Natural History Societies, have aided in promoting the good feeling that it is desirable to keep up amongst workers in the same field of research.

The Conversazione held on the 14th of March last was very successful, though the attendance was hardly so numerous as at

some former Soirées. Your Committee remark with satisfaction the continued improvement in the character of the objects shown on these occasions, and the greater care taken in their display than was formerly the case.

The attendance at the meetings, both ordinary and conversational, has been very good; at that of Feb. 28th there were assembled the largest number ever present at an ordinary meeting of the Club.

The illustrations of elementary subjects at the conversational meetings have for the most part been discontinued, owing to the expression of opinion by some of the members that they interfered with the freedom of intercommunication essential to the character of the "Gossip Nights."

Your Committee consider that it will be for the benefit of the Club that an additional Honorary Secretary should be appointed. The members have now before them the proposal for the alteration in the Rules necessary for effecting this change. This alteration is so framed as to allow of a return to the original arrangement should circumstances render that course advisable.

The balance in the Treasurer's hands is satisfactory, though not so large as last year, on account of the expense of the Conversazione.

Owing to unavoidable circumstances the Journal is considerably in arrear, but steps are being taken for its production with greater promptness in future. The value of the papers contained in it continues from time to time to be recognized by the references made to them in other scientific publications.

Your Committee beg to thank the officers of the Club for their effective performance of the work of their various departments.

Your Committee consider that the present position of the Club is satisfactory, and that it is fulfilling the purposes for which it was originally constituted; and they venture to hope that, by the continued exertion of its members, it may take a still larger share in the important and interesting work of Scientific Education.

TREASURER'S STATEMENT OF ACCOUNT.

Dr. June 30th, 1879.	£	s.	d.	Cr. June 30th, 1879.	£	s.	d.
To Balance in hand July 1st, 1878	106	13	5	By Printing and Stationery	51	0	6
,, Subscriptions received	251	5	0	,, Postage	9	5	8
,, Dividends on Compounding-Fees	1	6	0	,, Attendance	10	10	0
,, Sale of Journals	13	16	2	,, Property Purchased	18	5	9
				,, Petty Expenses	15	17	6
				,, Journal	95	11	3
				,, Soirée	85	0	8
				,, Balance in hand	87	9	3
	£373	0	7		£373	0	7

MR. CRISP'S DONATION FUND ACCOUNT.

To Balance in hand July 1st, 1878	25	5	10	By Balance in hand	45	5	10
,, Third Donation	20	0	0				
	£45	5	10		£45	5	10

Amount invested in New 3 per Cent. Annuities, £40.

We, the undersigned, having examined the above statement of Income and Expenditure, and the Vouchers relating thereto, hereby certify the same to be correct.

WM. HAINWORTH, JUN.,
H. H. DOBSON, } *Auditors.*

HONORARY MEMBERS.

Date of Election.	
Jan. 24, 1868	Arthur Mead Edwards, M.D. (*Ex-President of the American Microscopical Society: President of the Newark Scientific Association*), 120, Belleville Avenue, Newark, New Jersey, U.S.A.
Mar. 19, 1869	Rev. E. C. Bolles (*Ex-President of the Portland Society of Natural History*), Salem, Mass., U.S.A.
July 26, 1872	S. O. Lindberg, M.D., Professor of Botany, University of Helsingfors, Finland.
July 26, 1872	Prof. Hamilton L. Smith, President of Hobart College, Geneva, New York, U.S.A.
July 26, 1872	J. J. Woodward, Assist. Surgeon, U.S.A., War Department, Surgeon General's Office, Washington.
July 24, 1874	W. Sharpey, M.D., F.R.S., &c., 50, Torrington-square, W.C.
July 23, 1875	Lionel S. Beale, M.B., F.R.S., F.R.M.S., &c., 61, Grosvenor-street, W.
Sept. 22, 1876	Frederick Kitton, Hon. F.R.M.S., &c., 10, Haymarket, Norwich.
July 25, 1879	W. B. Carpenter, C.B., M.D., F.R.S., &c., &c., 56, Regent's-park-road, N.W.
July 25, 1879	Dr. E. Abbe, University, Jena, Saxe Weimer, Germany.

LIST OF MEMBERS.

Date of Election.	
Sept. 24, 1869	Ackland, William, L.S.A., F.R.M.S., 416 Strand, W.C.
June 23, 1876	Addis, W., 44 Herbert-street, New North-road, Hoxton, N.
Nov. 27, 1868	Adkins, William, 268 Oxford Street, W.
Mar. 23, 1866	Allbon, W., F.R.M.S., 525 New Oxford-street, W.C.
April 25, 1879	Allen, Edward H., 17 Carlisle-street, W.
Jan. 25, 1878	Allinson, John, M.R.C.S., Oxford-rd., Walthamstow.
June 23, 1876	Allison, Charles, 71 Graham-road, Dalston, E.
July 26, 1872	Alstone, John, Fortis-green, N.
Dec. 17, 1869	Ames, George Ackland, F.R.M.S., Union Club, Trafalgar-square, W.C.
Sept. 25, 1868	Andrew, Arthur R., 1 St. George's-villas, Middleton-road, Hornsey, N.
Dec. 22, 1865	Andrew, F. W., 3 Neville-terrace, Onslow-gardens, S.W.
July 7, 1865	Archer, J. A., 172 Strand, W.C.
May 28, 1875	Arrowsmith, Wastell, 99 Adelaide-road, Haverstock-hill, N.W.
July 25, 1879	Ashbridge, Arthur, 76 Leadenhall-street, E.C.
Sept. 27, 1878	Ashby, H. T., 8 Bartholomew-road, Kentish-town, N.W.
Nov. 24, 1876	Atkins, Walter George, Mem. Soc. Eng., 62 Fleet-street, E.C.
Dec. 22, 1865	Atkinson, John, 33 Brook-street, W.
Feb. 26, 1869	Atkinson, Wm., F.L.S., 47 Gordon-square, W.C.
Jan. 24, 1879	Avery, Arthur, 40 Belsize-park, N.W.
July 23, 1875	Ayling, J. J., 37 Edward-st., Newington-butts, S.E.

Date of Election.	
June 26, 1874	Badcock, John, F.R.M.S., 2 Banbury-road, South Hackney, E.
Dec. 27, 1867	Bailey, John W., 75 Broke-road, Dalston, E.
April 24, 1868	Baker, Chas., F.R.M.S., 244 High Holborn, W.C.
May 25, 1877	Baker, G. Levett, 15 Windsor-road, Denmark-hill.
Feb. 25, 1876	Ballard, Dr. W. R., jun., 26 Manchester-square, W.
Jan. 24, 1879	Barham, Geo. Titus, Danehurst, Hampstead, N.W.
July 28, 1876	Barnard, Hy., 1 St. Peter's-road, De Beauvoir-square, Kingsland-road, N.
Dec. 27, 1872	Barnard, Herbert, 33 Portland-place, W.
April 22, 1870	Barnes, Chas. Barritt, 4 Egremont-villas, White Horse-lane, South Norwood, S.E.
Aug. 28, 1874	Barnett, E. W., The Larches, Penge-lane, Sydenham, S.E.
Sept. 27, 1872	Bartlett, Edward, jun., L.D.S., M.R.C.S.E., 40 Elgin-road, St. Peter's-park, W.
Oct. 26, 1877	Basevi, Col. G. H., Elm Lodge, Prestbury, Cheltenham.
Dec. 28, 1877	Batchelor, J. A., 10 Loughborough-park-road, Brixton, S.E.
May 22, 1874	Bate, George Paddock, M.D., F.R.C.S.E., F.R.M.S., 412 Bethnal Green-road, E.
July 26, 1878	Battersby, John, 61 Queen's-road, St. John's-wood, N.W.
Nov. 26, 1875	Bayfield, Chas. Moulden, 2 Leamington-road-villas, Westbourne-park, W.
Mar. 27, 1874	Beach, Richard J., 59 Ashburton-grove, Lower Holloway, N.
Jan. 25, 1878	Beaman, Geo. Hulme, 80 Moray-road, Tollington-park, N.
May 28, 1869	Bean, Charles E., Brooklyn-house, Goldhawk-road, Shepherd's-bush, W.
Feb. 28, 1879	Bear, John, 2 Birkbeck-grove, Acton, W.
Nov. 26, 1875	Beaulah, John, Bracken-hill, Brigg.
May 24, 1878	Beddard, Frank E., New College, Oxford.
May 26, 1871	Bedwell, Fras. Alfred, M.A. Cantab., F.R.M.S., Fort Hall, Bridlington Quay, Yorkshire.
Mar. 24, 1871	Bentley, Algernon Royds, 36 Portland-place, W.
Dec. 27, 1867	Bentley, C. S., F.R.M.S., Hazelville-villa, Sunny-side-road, Hornsey-rise, N.

Date of Election.	
May 22, 1868	Berney, John, F.R.M.S., 61 North-end, Croydon.
Oct. 23, 1868	Bevington, W. A., F.R.M.S., 80 Avondale-square, Old Kent-road, S.E.
Mar. 28, 1879	Bird, Fredk. Elliott, 36 Stockwell-road, Clapham, S.W.
July 28, 1871	Bishop, Wm., 4 Whitley-villas, Caledonian-rd., N.
Feb. 23, 1866	Blake, T., 6 Charlotte-terrace, Brook-green, Hammersmith, W.
Mar. 19, 1869	Blankley, Frederick, F.R.M.S., 15 Belitha-villas, Barnsbury, N.
July 27, 1877	Blenkinsop, Benj., Sec. Hand-in-Hand Insurance Office, New Bridge-street, Blackfriars, E.C.
May 26, 1876	Blundell, Joseph, St. George's Club, 2 Savile-row, W.
Jan. 25, 1878	Bogue, David, F.R.M.S., 3 St. Martin's-place, Trafalgar-square, W.C.
Oct. 24, 1873	Bolton, Major Frank, 21 Victoria-mansions, S.W.
Jan. 22, 1875	Bolton, Thos., F.R.M.S., 17 Ann-st., Birmingham.
Jan. 24, 1879	Bond, R. C. C., 47 Great Russell-street, W.C.
May 23, 1879	Bonser, Edward, 51 St. Augustin's-road, Camden-square, N.W.
April 22, 1870	Bossy, Alfred Horsley, Walton-lodge, 118 Stoke Newington-road, N.
Jan. 28, 1876	Bowcher, W., 6 Brownswood-villas, Stroud Green-road, N.
June 26, 1874	Brady, Henry.
Oct. 27, 1865	Braithwaite, R., M.D., M.R.C.S.E., F.L.S., F.R.M.S., The Ferns, 303 Clapham-road, S.W.
May 25, 1877	Bramhall, Rev. John, R.D., Terrington St. John's, near Lynn, Norfolk.
June 28, 1878	Brewster, W., 69 Myddleton-square, E.C.
May 26, 1876	Brigstock, John Wm., 4 Comberton-road, Upper Clapton, E.
May 27, 1870	Brown, George Dransfield, M.R.C.S., Henley-villa, Uxbridge-road, Ealing, W.
May 22, 1868	Brown, W. J., 4 Marlbro'-terrace, Maple-road, Penge, S.E.
May 26, 1871	Browne, George, 45 Victoria-road, N.W.
May 28, 1875	Browne, J. W., Frascati, Mason's-hill, Bromley, Kent.

Date of Election.	
Feb. 27, 1872	Browne, Rev. Thomas Henry, F.R.M.S., F.G.S., M.E.S., High Wycombe, Bucks.
Jan. 26, 1877	Buffham, T. Hughes, Clarence-villas, Clarendon-road, Walthamstow.
Sept. 27, 1872	Bugby, Wm., 3 Wilton-villas, Uxbridge-road, W.
May 22, 1874	Burgess, John James, 1 Copthall-chambers, E.C.
Sept. 27, 1872	Bush, Wm., Hanworth-house, Hanworth.
May 23, 1879	Button, Arthur, 123 Brecknock-road, N.W.
Aug. 24, 1877	Buxton, A. St. Clair, M.R.C.S., L.R.C.P., L.M., 17 Stowe-road, Shepherd's-bush, W.
June 14, 1865	Bywater, Witham M., F.R.M.S., 5 Hanover-square, W.
Nov. 22, 1878	Cafe, James Watt, 46 Clifton-hill, St. John's-wood, N.W.
Sept. 22, 1876	Canton, Fredk., L.R.C.P., M.R.C.S., &c., 17 Great Marlborough-street, Regent-street, W.
Dec. 17, 1875	Caplatzi, A., 1 North-crescent, Bedford-square, W.C.
May 23, 1879	Carpenter, H. S., F.R.M.S., Beckington-house, Weighton-road, Anerley, S.E.
May 22, 1874	Carruthers, Herbert.
May 26, 1871	Catchpole, Robert, 10 The Mall, Ealing, W.
April 25, 1879	Cazaux, Denis B., F.R.M.S., 61 Finsbury-park-road, N.
April 25, 1879	Chantrell, George F. (*V.P. and late Pres. Liverpool Mic. Soc.*), 1 St. James's-mount, Liverpool.
Dec. 27, 1878	Chatto, Andrew, 74 Piccadilly, W.
Oct. 22, 1875	Cheshire, F., Avenue-house, Acton, W.
Nov. 27, 1874	Chippindale, Geo., 44 Highgate-road, N.W.
Mar. 24, 1876	Clarkson, A., 49 Southampton-street, Pentonville-road, N.
May 22, 1874	Clayton, James, 25 Hemingford-road, Islington, N.
Oct. 25, 1878	Clifford, Rev. H. M., M.A., 43 Onslow-gardens, S.W.
July 25, 1879	COBBOLD, T. SPENCER, M.D., F.R.S., F.L.S., (*President*), 74 Portsdown-road, Maida-vale, W.
May 22, 1868	Cocks, W. G., 36 Gayhurst-road, Dalston, E.
Sept. 22, 1876	Cole, Arthur C., F.R.M.S., St. Domingo-house, Oxford-gardens, Notting-hill, W.

Date of Election.	
Nov. 27, 1874	Cole, B. G., Laurel-cottage, King's-place, Buckhurst-hill, Essex.
April 24, 1874	Cole, Wm., M.E.S., Laurel-cottage, King's-place, Buckhurst-hill, Essex.
Jan. 25, 1867	Coles, Ferdinand, F.L.S., 341 Amhurst-road, Stoke Newington, N.
Mar. 24, 1876	Colsell, Geo. Dannett, 5 Austin-friars, E.C.
Feb. 23, 1872	Colvin, Alexander, Beaconside, Penrith, Cumberland.
Sept. 27, 1872	Connolly, Charles T., L.S.A., 3 Church-hill-villas, Wood-green, N.
June 14, 1865	Cooke, M. C., M.A., LL.D., A.L.S. (*Hon. Sec. for Foreign Correspondence*), 2 Grosvenor-villas, Junction-road, Upper Holloway, N.
May 28, 1875	Cooper, Chas., Jesmond-cottage, Walham-green, S.W.
Feb. 22, 1867	Cooper, Frank W., L.R.C.S. Edin., Leytonstone, E.
June 27, 1873	Corbett, Alfred L., 103 Fentiman-road, Clapham-road, S.W.
May 28, 1869	Cottam, Arthur, F.R.A.S., H.M. Office of Woods, Whitehall-place, S.W.
Jan. 28, 1876	Cotton, Thos., M.D., 214 Seven-sisters'-road, N.
July 26, 1872	Cowan, Thos. Wm., F.G.S., F.R.M.S., Compton Lea, Horsham, Sussex.
May 25, 1877	Coxhead, Albert C., 47 Russell-square, W.C.
Aug. 28, 1868	Crisp, Frank, LL.B., B.A. Lond., F.L.S. (*Hon. Sec. R.M.S.*), 5 Lansdowne-road, Notting-hill, W.
Dec. 23, 1870	Crisp, John S., F.R.M.S., Ashville, Lewin-road, Streatham, S.W.
July 26, 1878	Crockford, Wm., 2 St. Peter's-road, Mile-end, E.
Aug. 24, 1877	Croft, R. C., M.D., 204 Camden-road, N.W.
Feb. 23, 1877	Crofton, Edward, M.A. Oxon., F.R.M.S., 45 West Cromwell-road, South Kensington, S.W.
Sept. 28, 1866	Crouch, Henry, F.R.M.S., 66, Barbican, E.C.
June 22, 1877	Cunliffe, P. G., F.R.M.S., The Elms, Handforth, Manchester.
Nov. 26, 1875	Cunningham, Francis Bertram, 8 Durham-terrace, Westbourne-park, W.
May 25, 1866	Curties, T., F.R.M.S., 244 High Holborn, W.C.

Date of Election.	
Jan. 22, 1875	Dadswell, Edward (*Hon. Sec. S. Lond. Mic. and Nat. Hist. Soc.*), 42 Barrington-road, Stockwell, S.W.
Nov. 23, 1877	Dallas, Wm. S., F.L.S., &c., The Geological Society, Burlington-house.
May 23, 1879	Dallmeyer, Thos. R., 19 Bloomsbury-street, W.C.
Mar. 22, 1878	Darby, The Ven. Archdeacon, St. Bridget's Rectory, Chester.
Mar. 22, 1878	Darke, Edward, 2 Brecknock-crescent, Camden-road, N.W.
June 25, 1868	Darnley, D. Rowland, Ealing Dean, W.
Oct. 24, 1873	Dashwood, Horace, 192 St. Paul's-road, Canonbury, N.
July 23, 1871	D'Aubney, Thos., Shepherdess-walk, Hoxton, N.
May 23, 1874	Davey, Robert F., War Office, Pall-mall, S.W.
Oct. 22, 1869	Davis, Henry, 19 Warwick-street, Leamington.
May 23, 1879	Dawson, Wm., 24 Abbeygate-street, Bury St. Edmunds, Suffolk.
May 28, 1875	Dean, Arthur, 11, Caxton-street, Addington-road, Bow, E.
Feb. 23, 1877	Death, James, Jun., 38, Gladstone-street, St. George's-road, Southwark, S.E.
Feb. 28, 1879	Debenham, Edw. H., 9 Mincing-lane, E.C.
Jan. 24, 1879	Deby, Julien, C.E., F.R.M.S., 72 Warwick-gardens, Kensington, W.
May 28, 1875	Defriez, Joseph George, M.R.C.S., L.S.A., 173 Bethnal-green-road, E.
Feb. 23, 1877	Delferier, Wm. Adrien, 15 Penywern-road, South Kensington, S.W.
Nov. 24, 1876	Despointes, Francis, 16 St. George's-square, Regent's-park-road, N.W.
June 26, 1868	Dickens, Charles, Latimer-house, Hadley, Middlesex.
Jan. 28, 1876	Dillnot, Geo., Hayling, Havant, Hants.
May 23, 1879	Dixon, Wm. Fras., 18 University-street, W.C.
Nov. 24, 1865	Dobson, H. H., F.R.M.S., Holmesdale, Grange-park, Ealing.
July 26, 1872	Doggett, Fredk. Ernest, Reid's Brewery, Liquor-pond-street, E.C.
Nov. 27, 1868	Douglas, Rev. R. C., Manaton-rectory, Moreton-hampstead, Exeter.

Date of Election.	
Oct. 25, 1878	Dowler, Captain F. E., Naval and Military Club, Piccadilly, W.
Jan. 28, 1870	Dowson, Edward, M.D., M.R.C.S., F.R.M.S., 117 Park-street, Grosvenor-square, W.
Nov. 22, 1878	Drayton, H. F. Ernest, Horton-house, Beckenham, Kent.
July 28, 1871	Drew, G. C., Milton-house-school, Clapton-common. S.E.
July 25, 1879	Driver, Alfred, 8 Victoria-chambers, Westminster, S.W.
Aug. 26, 1872	Dudgeon, R. E., M.D., 53 Montagu-square, W.
Oct. 25, 1872	Dunning, Chas. G., 22 Oseny-crescent, Camden-road, N.W.
Sept. 22, 1865	Durham, Arthur E., F.R.C.S., F.L.S., F.R.M.S., &c., 82 Brook-street, Grosvenor-square, W.
Jan. 24, 1879	Easty, Chas. Wm., 19 Edith-road, St. Mary's-road, Peckham, S.E.
Sept. 25, 1868	Eddy, James Ray, F.R.M.S., F.G.S., The Grange, Carleton, Skipton, Yorkshire.
June 28, 1867	Edmonds, R., 178 Burrage-road, Plumstead, S.E.
May 26, 1876	Emery, Charles (*Hon. Curator*), 6 Laburnam-cottages, Middle-lane, Crouch-end, N.
May 26, 1871	Enock, Fredk., 30 Russell-road, Seven Sisters'-road, N.
Feb. 28, 1879	Epps, Hahnemann, West-house, North-end, Hampstead, N.W.
Dec. 27, 1878	Erlebach, H. A., Chard, Somerset.
Dec. 17, 1875	Farries, Thomas, F.C.S., 7 New Basinghall-st., E.C.
July 25, 1873	Fase, Rev. H. J., 5 Bessborough-gardens, S.W.
June 25, 1875	Faulkner, Hy., jun., Fernwood, Roehampton-park, S.W.
Jan. 28, 1876	Faulkner, John, 2 Mornington-crescent, N.W.
July 26, 1867	Fitch, Frederick, F.R.G.S., F.R.M.S., Hadleigh-house, Highbury New-park, N.
Mar. 24, 1871	Foulerton, J., M.D., Scientific-club, 4 Savile-row, W.
July 26, 1878	Fowke, Francis, F.R.M.S., Thatched-house Club, St. James's-street, S.W.

Date of Election.	
Dec. 28, 1866	Fox, C. J., F.R.M.S., 26 South Molton-street, Oxford-street, W.
Nov. 26, 1875	Freckelton, Rev. T. W., F.R.M.S., 28A Lonsdale-square, Islington, N.
June 23, 1871	Freeman, Henry E., 1 Templeton-road, Finsbury-park, N.
Feb. 26, 1869	Fricker, C. J., 4 Westow-hill-terrace, Upper Norwood, S.E.
May 22, 1868	Fryer, Geo. H., 82 Belsize-road, N.W.
Oct. 26, 1868	Furlonge, W. H., Coed-Mawr-house, Holywell, Flintshire.
Mar. 19, 1869	Gann, James W., 171 Fenchurch-street, E.C.
Mar. 25, 1870	Garden, Robert Spring, 42 Carlton-hill, St. John's-wood, N.W.
May 25, 1866	Gardiner, G., F.M.S., 23 St. Paul's-road, N.W.
Feb. 26, 1875	Gardner, Edmund, 454 Strand, W.C.
July 27, 1877	Gardner, J. H., A.K.C., Royal Polytechnic Institution, Regent-street, W.
April 24, 1868	Garnham, John, F.R.M.S., 123 Bunhill-row, E.C.
July 7, 1865	Gay, F. W., F.R.M.S. (*Hon. Treasurer*), 113 High Holborn, W.C.
Jan. 28, 1870	Gellatly, Peter, Loughton, Essex.
July 26, 1867	George, Edward, F.R.M.S., 12 Derby-villas, Forest-hill, S.E.
Sept. 27, 1878	Gibbes, Heneage, F.R.M.S., 42 Colville-terrace, Bayswater, W.
April 26, 1878	Gibbins, G. W., 44 Parkfield-street, Islington, N.
July 22, 1870	Gibson, Joseph F., F.R.M.S., Clovelly, Woodchurch-road, West Hampstead, N.W.
June 14, 1865	Gibson, W., 3 Bridge-street, Westminster, S.W.
April 27, 1877	Gilbertson, Henry, Mangrove-house, Hertford.
Oct. 27, 1876	Gilburt, W. H., F.R.M.S., 42 Malmesbury-road, Bow, E.
June 27, 1873	Glasspoole, Hampden G., 34 Bernard-st., Russell-square, W.C.
Feb. 25, 1876	Godwin, John, 219 Brompton-road, S.W.
Nov. 22, 1872	Goodchild, J. E., Prospect-hill-lodge, Walthamstow, E.

Date of Election.	
April 26, 1872	Goodinge, James Wallinger, F.R.G.S., F.R.M.S., 18 Aldersgate-street, E.C.
Nov. 23, 1877	Goodwin, Wm., 93 Birkbeck-road, Hornsey-rise, N.
Mar. 27, 1866	Gray, S. Octavus, Bank of England, E.C.
Dec. 22, 1865	Gray, W. J., M.D., F.R.M.S., 41 Queen Anne-street, Cavendish-square, W.
Nov. 27, 1874	Grayling, J. Francis.
May 22, 1874	Green, G., 6 Helmet-row, St. Luke's, E.C.
Jan. 28, 1870	Green, Nathaniel E., F.R.A.S., 39 Circus-road, St. John's-wood, N.W.
Oct. 23, 1868	Greenish, T., F.R.M.S., 20 New-street, Dorset-square, N.W.
Oct. 23, 1868	Gregory, Henry R., 38 Welbeck-street, W.
May 23, 1873	Gregory, William, 406 Strand, W.C.
May 22, 1874	Grey, Ernest, 290 Essex-road, Islington, N.
July 24, 1868	Groves, J. W., 55 Russell-square, W.C.
July 24, 1868	Grubbe, E. W., C.E., 49 Queen's-gardens, Hyde-park, W.
Jan. 27, 1871	Guimaraens, Augustus de Souza, F.R.M.S., 50 Lowden-road, Herne-hill, S.E.
Aug. 24, 1877	Habirshaw, Fredk., F.R.M.S., 6 West 48th Street, New York, U.S.A.
Aug. 24, 1877	Habirshaw, John, M.D., F.R.M.S., 6 West 48th Street, New York, U.S.A.
Jan. 23, 1874	Hadland, J. H., 11 King William-street, E.C.
Sept. 28, 1877	Hagger, John, Repton School, Burton-on-Trent.
June 14, 1865	Hailes, Henry F. (*Hon. Secretary, Elected Sept.* 26, 1879), 7 Haringay-road, Hornsey, N.
Aug. 26, 1870	Hailstone, Robert H., 91 Adelaide-road, N.W.
Feb. 23, 1867	Hainworth, W., jun., Clare-villa, Cricketfield-road, Lower Clapton, E.
July 28, 1876	Halford, Edwd., 18 Leinster-square, Bayswater, W.
Dec 28, 1866	Hallett, R. J., 123 Seymour-st., Euston-sq., N.W
Nov. 26, 1875	Halley, Alex. Hay, 7 Elgin-road, Kensington-park, W.
Mar. 28, 1879	Hallowes, Fras., F.R.G.S., F.Z.S., Scientific Club, Savile-row, W.
Feb. 22, 1869	Hammond, A., 4 Neptune-terrace, Marine-town, Sheerness.

Date of Election.	
Jan. 24, 1879	Harding, Burcham, 128 Adelaide-road, N.W.
July 25, 1879	Hardingham, George Gatton, F.R.M.S., 33 St. George's-square, S.W.
Jan. 23, 1874	Hardy, James Daniel, 73 Clarence-road, Clapton, E.
Sept. 28, 1866	Harkness, W., F.R.M.S., Laboratory, Somerset-house, W.C.
May 23, 1879	Harris, C. J., M.R.C.S., L.S.A., 11 Kilburn-priory, N.W.
June 23, 1871	Harris, Edward, F.R.M.S., Rydal-villa, Longton-grove, Upper Sydenham, S.E.
Jan. 25, 1878	Harrison, D. H., Argyll-villas, Mattock-lane, Ealing, W.
April 23, 1875	Harrison, James, 150 Akerman-road, North Brixton, S.W.
July 26, 1872	Harrod, John, Mark-lane-square, E.C.
Nov. 26, 1869	Hart, Edward, Highbury New-park, N.
Jan. 26, 1877	Harvey, G., 45 High-street, Kensington, W.
Mar. 28, 1879	Hawkins, C. E., H.M. Geological Survey, Jermyn-street, S.W.
June 24, 1870	Hawkins, S. J., 27 Lichfield-grove, Finchley, N.
June 28, 1867	Hawksley, Thos. P., 97 Adelaide-road, N.W.
Sept. 28, 1877	Headley, Robt., F.R.G.S., 44 Walham-grove, Walham-green, S.W.
Aug. 23, 1872	Hembry, F. W., 150 Stockwell-park-road, Brixton, S.W.
Aug. 26, 1870	Hennell, Col. S., F.R.M.S., Ventnor-villa, Ventnor, Isle of Wight.
June 26, 1868	Henry, A. H., 49 Queen's-gardens, Hyde-park, W.
June 26, 1874	Hewitt, W. W., F.R.M.S., 5 Torriano-gardens, Camden-road, N.W.
May 22, 1868	Hicks, J. J., 8 Hatton-garden, E.C.
June 22, 1877	Hill, Rd. W., 41 Lothbury, E.C.
Sept. 24, 1869	Hilton, T. D., M.D., Upper Deal, Deal, Kent.
Sept. 28, 1866	Hind, F. H. P., Bartholomew-house, Bartholomew-lane, E.C.
May 22, 1874	Hind, George, 244 High Holborn, W.C.
July 26, 1872	Hinton, Ernest.
Aug. 26, 1870	Hirst, John, F.R.M.S., Ladcastle, Dobcross, Manchester.

Date of Election.	
Feb. 26, 1875	Holford, Chr., Bounty-office, Dean's-yard, Westminster, S.W.
April 26, 1867	Hooton, C., Sunningdale-house, Bickerton-road, Upper Holloway, N.
May 22, 1868	Hopkinson, John, F.L.S., F.R.M.S., F.G.S., Wansford-house, Watford.
April 28, 1876	Horn, Wm. E., A.I.C.E., 10 Vincent-square, Westminster, S.W.
Oct. 26, 1866	Horncastle, H., Whitemoor house, near Ollerton, Notts.
June 25, 1869	Houghton, W., Hoe-street, Walthamstow, E.
May 22, 1874	Hovenden, C. W., F.R.M.S., 95 City-road, E.C.
April 26, 1867	Hovenden, F., F.R.M.S., Glenlea, Thurlow-park-road, Dulwich, S.E.
June 23, 1876	How, Wm. Samuel, 75 Great Portland-street, W.
Oct. 27, 1876	Howard, D., 60 Belsize-park, N.W.
Jan. 22, 1875	Howard, F. W., The Grove, Teddington.
Oct. 25, 1878	Howling, Wm. Edward, The New Westminster Brewery Company, Earl-street, Horseferry-road, S.W.
Feb. 25, 1870	Hudleston, W. H., J.P., F.G.S., 23 Cheyne-walk, S.W.
Feb. 28, 1879	Hudson, C. T., M.A., LL.D. Cantab., V.P.R.M.S., Manilla Hall, Clifton, Bristol.
Jan. 26, 1872	Hudson, Robert, F.R.S., F.L.S., F.R.M.S., &c., Clapham-common, S.W.
Dec. 28, 1866	Hunt, W. H. B., F.R.M.S., 23 Eversholt-street, Oakley-square, N.W.
Oct. 22, 1875	Hunter, John, 5 Eton-rise, Ealing, W.
Dec. 22, 1876	Hunter, J. J., 20 Cranbourne-street, W.C.
July 25, 1873	Hurst, John Thomas, Royal Engineer Office, Portsmouth.
Nov. 25, 1870	Hutton, Rev. Wyndham M., Hungarton Vicarage, Leicester.
June 28, 1878	Huxley, Prof. T. H., F.R.S., &c. (*Vice-President*), Science Schools, South Kensington.
May 24, 1867	Ingpen, J. E., F.R.M.S. (*Hon. Secretary*), 7 The Hill, Putney, S.W.

Date of Election.	
May 23, 1879	Isaac, Thos., Maldon, Essex.
Aug. 22, 1873	Israel, S., 1 The Crescent, America-square, E.C.
Dec. 17, 1869	Jackson, B. D., F.R.M.S., 30 Stockwell-road, S.W.
Dec. 17, 1875	Jackson, C. L., F.Z.S., F.R.M.S., Hill Fold, Bolton.
July 24, 1868	Jackson, F. R., Culver-cottage, Slindon, Arundel, Sussex.
Feb. 22, 1878	James, Robt. M. C., Fennymere, Castlebar, Ealing.
June 14, 1865	Jaques, Edward, B.A., F.R.M.S., Office of Woods, Whitehall-place, S.W.
Feb. 28, 1873	Jenkins, J. W., 1 St. John's-hill, Wandsworth, S.W.
July 24, 1868	Jennings, Rev. Nathaniel, M.A., F.R.A.S., 1 Grove-terrace, Highgate-road, N.W.
Jan. 25, 1867	Johnson, John A., 15 Wellington-road, Stoke Newington, N.
Feb. 24, 1871	Johnson, M. Hawkins, F.R.M.S., F.G.S., 379 Euston-road, N.W.
June 23, 1876	Johnson, Tom Richard, Gordon-house, Highgate-road, N.W.
Feb. 23, 1877	Johnston, J. M. C., 161 Grove-lane, Camberwell, S.E.
Mar. 24, 1871	Johnstone, James, Stanhope-lodge, Bideford.
Oct. 25, 1872	Jones, E. W., F.R.A.S., F.R.M.S., 53 Cowley-road, North Brixton, S.W.
Feb. 28, 1873	Jones, Geo. J., 38 St. Thomas-street, Lymington, Hants.
June 25, 1875	Jones, J. Birdsall, F.R.M.S., care of W. R. Jones, Esq., Athenæum, Liverpool.
Nov. 25, 1870	Jones, Lieut.-Col. Lewis, Ambarrow-house, Sandhurst, Wokingham.
May 23, 1873	Jones, Captain Loftus F., United Service Club, Pall Mall, S.W.
June 23, 1876	Jones, Thomas Edwd., 46 Park-street, Stoke Newington, N.
May 22, 1874	Jones, W. W., 14 Lancaster-street, Lancaster-gate, Hyde-park, W.

Date of Election.	
May 23, 1873	Karop, Geo. C., M.R.C.S., &c., 198 Holland-road, Kensington, W.
Mar. 23, 1877	Keene, John H., The Cottage, Bishopsgate, near Staines.
Dec. 27, 1878	Kellow, Frank C., 51 Alexandra-road, St. John's-wood, N.W.
Aug. 23, 1867	Kiddle, Edward, The War Office, Pall Mall, S.W.
Mar. 19, 1869	Kilsby, Thomas W., 4 Brompton-villas, Edmonton.
June 23, 1876	Kindon, Chas. J., 30 Overton-road, Brixton, S.W.
Dec. 23, 1870	King, Robert, F.R.M.S., Fern-house, Upper Clapton, E.
May 24, 1878	King, Wm. Talbot, M.D., M.R.C.S., 74 Victoria-park-road, South Hackney, E.
April 26, 1867	Kirk, Joseph, 11 Blossom-st., Norton Folgate, E.
Nov. 27, 1874	Kirkman, Rev. Joshua, Thurlow-road, South Hampstead, N.W.
Feb. 28, 1873	Kitsell, Francis J., 7 John's-terrace, Latymer-road, W.
Mar. 23, 1877	Kluht, Hy. J., 42 Westbourne-grove, Bayswater, W.
May 25, 1877	Knaggs, Hy. Valentine, 189 Camden-road, N.W.
Oct. 24, 1873	Knight, John Mackenzie, 50 Bow-road, E.
Nov. 25, 1870	Ladd, Wm., F.R.A.S., F.R.M.S., 12 Beak-street, Regent-street, W.
Nov. 23, 1866	Lambert, W., 1 New Broad-street, E.C.
Jan. 24, 1879	Lancaster, Arthur H., 7 Campden-hill-gardens, Kensington, W.
Mar. 22, 1867	Lancaster, Thos., Bownham-house, Stroud, Gloucestershire.
May 25, 1877	Lane-Fox, Hon. Sackville F. H., 22 Camden-cottages, Camden-road, N.W.
May 28, 1875	Larkin, John, 24 Charterhouse-square, E.C.
May 28, 1875	Laws, Joseph C., 41 St. John's-park, Upper Holloway, N.
June 25, 1869	Layton, Charles E., 12 Upper Hornsey-rise, N.
Aug. 28, 1868	Leaf, C. J., F.L.S., F.R.M.S., &c. (*President of the Old Change Microscopical Society*), Old Change, E.C.
Mar. 19, 1869	Lee, Henry, F.L.S., F.R.M.S., &c., The Waldrons, Croydon.

Date of Election.	
May 27, 1874	Leefe, Frederick Ewbank, 289 Goswell-road, E.C.
June 23, 1876	Leeson, Herbert Seymour, 4 Old-buildings, Lincoln's-inn, W.C.
Oct. 25, 1867	Leifchild, J. R., M.A., 21 St. Lawrence-road, Notting-hill, W.
Sept. 22, 1865	Leighton, W. H., 2 Merton-place, Chiswick, W.
July 25, 1873	Le Pelley, C., 17 Underwood-street, Shepherdess-walk, Hoxton, N.
April 27, 1866	Lewis, R. T., F.R.M.S. (*Hon. Reporter*), 1 Lowndes-terrace, Knightsbridge, S.W.
June 26, 1868	Lindley, W., jun., Kidbrook-terrace, Blackheath, S.E.
Jan. 25, 1878	Lindsay, H. B., 13 Charles-street, Berkeley-square, W.
May 26, 1871	Locke, John, 16 Georgiana-street, Camden-town, N.W.
April 23, 1869	Long, Henry, 90 High-street, Croydon.
Nov. 24, 1866	Lovibond, J. W., F.R.M.S., St. Anne-street, Salisbury.
Sept. 22, 1865	Lovick, T., 53 Queen's-crescent, Haverstock-hill, N.W.
Dec. 18, 1868	Lowne, B. Thompson, F.R.C.S., F.L.S., F.Z.S., 49 Colville-gardens, Bayswater, W.
April 27, 1866	Loy, W. T., F.R.M.S., 11 Garrick-chambers, Garrick-street, W.C.
Nov. 23, 1866	McIntire, S. J., F.R.M.S., 22 Bessborough-gardens, S.W.
Jan. 26, 1872	Mackechnie, J. Hamilton, M.D., 60 Wimpole-street, Cavendish-square, W.
June 28, 1878	Magor, John Bernard, 6 Northumberland-street, Strand, W.C.
July 26, 1874	Magor, Thomas, M.D., Myddelton-road, Hornsey, N.
Feb. 28, 1879	Mann, James H., 2 Ampthill-square, N.W.
Sept. 27, 1872	Manning, H.E. the Cardinal Archbishop, Archbishop's House, Westminster, S.W.
Sept. 22, 1876	Martin, W. H., 11 Markham-square, Chelsea, S.W.
Dec. 27, 1867	Martinelli, A., 106 Albany-street, N.W.

Date of Election.	
Dec. 27, 1878	Martiney, M. G., 11 Castlenau-gardens West, Barnes, S.W.
Oct. 25, 1867	Marwood, W. G. H., 50 Cornhill, E.C.
April 26, 1867	Matthews, G. K., St. John's-lodge, Beckenham, Kent.
Oct. 26, 1866	Matthews, John, M.D., F.R.M.S. (*Vice-President*), 30 Colebrooke-row, Islington, N.
Jan. 26, 1877	Matthews, Wavell, 12 Wigmore-street, W.
Sept. 24, 1869	Matthews, William, 374 Camden-road, N.
May 26, 1871	May, John William, F.R.M.S., Arundel-house, Percy-cross, Fulham, S.W.
Feb. 27, 1874	May, Lewis J., 371 Holloway-road, N.
Dec. 17, 1875	May, Thomas, 54 Coburg-road, Old Kent-road, S.E.
Feb. 25, 1876	May, W. R., 69 St. Mark's-square, Dalston, E.
Feb. 28, 1873	Mayhew, A. F., 167 Long-lane, Bermondsey, S.E.
Mar. 22, 1867	Meacher, John W., 10 Hillmarten-road, Camden-road, N.
Feb. 28, 1879	Menzies, James, 140 Barnsbury-road, N.
May 22, 1874	Messenger, G. A., 21 Glengall-grove, Old Kent-road, S.E.
Dec. 18, 1868	Mestayer, Richard, F.L.S., F.R.M.S., 7 Buckland-crescent, Belsize-park, N.W.
July 27, 1877	Michael, Albert D., F.L.S., F.R.M.S. (*Vice-President*), 3 & 4 Great Winchester-street, E.C.
July 7, 1865	Millett, F. W., 21 Duncan-terrace, Islington, N.
May 25, 1866	Moginie, W., F.R.M.S., 26 Lichfield-grove, Finchley, N.
Jan. 23, 1874	Moreland, Richard, jun., M.I.C.E., F.R.M.S., 4 Highbury Quadrant, N.
July 26, 1878	Morland, Henry, Cranford, near Hounslow.
Oct. 27, 1866	Morrieson, Colonel R., F.R.M.S., Oriental Club, Hanover-square, W.
Dec. 27, 1876	Morris, J. Griffith, M.R.C.S., 135 St. Owen-street, Hereford.
Oct. 27, 1876	Morris, W. G., L.D.S., 12 White-friars, Chester.
Nov. 23, 1877	Morten, T. S., 40 Haverstock-hill, N.W.
Jan. 24, 1879	Murray, James, Osborne-house, 50 Percy-road, Shepherd's-bush, W.
Jan. 25, 1867	Murray, R. C., 69 Jermyn-st., St. James's, S.W.

Date of Election.	
Mar. 23, 1866	Nation, W. J., 30 King-square, Goswell-road, E.C.
Feb. 22, 1878	Needham, S. H., F.R.G.S., F.G.S., 5 Mecklenburg-street, Mecklenburg-square, W.C.
Mar. 24, 1876	Nelson, Edward M., 9 Marlborough-hill, N.W.
Mar. 24, 1871	Nelson, James, 3 Oakden-street, Kennington-road, S.E.
Feb. 28, 1879	Nesbitt, Henry, 12 Victoria-villas, Kilburn, N.W.
May 23, 1879	Newcombe, Prout, Northcote, East Croydon.
Nov. 23, 1877	Newth, A. H., M.D., Scientific Club, 4 Savile-row, W,
Jan. 26, 1872	Newton, Edwin Tulley, F.G.S., Geological Museum, Jermyn-street, S.W.
Aug. 24, 1877	Oates, Parkinson, M.D., L.S.A., M.R.C.S., 48 Lupus-street, S.W.
Jan. 24, 1879	Offord, John Milton, 31 Hereford-square, S.W.
Dec. 22, 1876	Ogilvy, C. P., F.L.S., Sizewell-house, Leiston, near Saxmundham, Suffolk.
May 24, 1878	O'Hara, Lt.-Col. Richard, F.R.M.S. (late Royal Artillery), West-lodge, Galway.
June 22, 1877	Oswin, Fred., F.S.A., 10 Gower-street, W.C.
Dec. 27, 1867	Oxley, F., F.R.M.S., 8 Crosby-square, Bishopsgate-street, E.C.
July 25, 1879	Palmer, Greville H., 95 Cornwall-gardens, S.W.
May 22, 1874	Palmer, Thomas, B.S., F.R.M.S., Holme Lee, Lower Camden, Chislehurst, Kent.
July 27, 1873	Parker, William, Whitehall Club, S.W.
Oct. 27, 1871	Parsons, Fred. A., 90 Leadenhall-street, E.C.
Dec. 28, 1877	Partridge, Thos., M.D., Stroud, Gloucestershire.
April 23, 1875	Peal, Charles Nathaniel, Fernhurst, Mattock-lane, Ealing, W.
May 22, 1874	Pearce, George Alonzo Creech, B.A., M.B , B.C.N., Priory-chambers, Crutched-friars, E.C.
May 24, 1867	Pearce, George, Villa Helvetia, Tufnell-park, N.
Feb. 23, 1872	Pearce, W. E. Grindley, L.R.C.P., 24 Bessborough-gardens, S.W.
April 27, 1877	Pearcy, Alfred Copley, 31 Packington-street, Islington, N.

Date of Election.	
May 24, 1867	Pearson, John, 212 Edgware-road, W.
Dec. 22, 1876	Perry, George, 82 Finborough-road, South Kensington, S.W.
Oct. 27, 1865	Pickard, J. F., 195 Great Portland-street, W.
May 23, 1879	Pilcher, Wm. John, F.R.C.S., &c., Boston, Lincolnshire.
Jan. 22, 1869	Pillischer, M., F.R.M.S., 88 New Bond-street, W.
Nov. 24, 1871	Pitts, Frederick, Harvard-house, St. John's-hill, Clapham, S.W.
Sept. 27, 1878	Plomer, Geo. Danl., F.R.M.S., 48 Springfield-road, St. John's-wood, N.W.
Sept. 28, 1877	Pocklington, Henry, F.R.M.S., Cedar-grove, Armley, Leeds.
Nov. 23, 1866	Potter, G., F.R.M.S., 42 Grove-road, Upper Holloway, N.
Jan. 25, 1878	Potts, R. A., 26 South Audley-street, W.
June 22, 1866	Powe, I., 71 George-street, Richmond, Surrey.
May 25, 1866	Powell, Hugh, F.R.M.S., 170 Euston-road, N.W.
April 25, 1879	Powell, Hugh Peter, The Baths, Brentford.
May 26, 1876	Powell, Jas. T., 12 Dalrymple-terrace, Glenarm-road, Clapton-park, E.
July 7, 1865	Powell, Thomas, 18 Doughty-street, Mecklenburg-square, W.C.
July 24, 1874	Powell, Thomas Henry, 7 Poultry, E.C.
Jan. 22, 1875	Power, H. D'Arcy, F.L.S., 109 Camberwell New-road, S.W.
April 25, 1879	Preedy, Wm. Halcomb, 38 Bartholomew-road, Kentish-town, N.W.
June 27, 1873	Priest, B. W., 22 Parliament-street, S.W.
May 23, 1879	Pritchard, J. D., Crymlyn Burrows, near Swansea.
July 26, 1867	Pritchett, Francis, 131 Fenchurch-street, E.C.
April 23, 1868	Quekett, Alfred J. S., 51 Warwick-road, Maida-hill, W.
April 23, 1868	Quekett, Arthur Edwin, 51 Warwick-road, Maida-hill, W.
April 23, 1868	Quekett, Rev. William, The Rectory, Warrington.
Feb. 23, 1866	Quick, George E., 109 Long-lane, Bermondsey, S.E.

Date of Election.	
Oct. 26, 1866	Rabbits, W. T., Highfield, Dartmouth-park, Forest-hill, S.E.
Sept. 24, 1869	Radcliffe, J. D.
June 25, 1875	Radford, W. S., M.D., F.R.M.S., Sidmouth.
Oct. 26, 1866	Ramsden, Hildebrand, M.A. Cant., F.L.S., F.R.M.S., Forest-rise, Walthamstow, E.
Aug. 28, 1868	Rance, T. G., Elmside, Bickley, Kent.
May 22, 1868	Rawles, W., 64 Kentish-town-road, N.W.
June 27, 1879	Readaway, Wm., 39 Robert-street, Hampstead-road, N.W.
June 23, 1876	Redmayne, John T., M.R.C.S., F.R.M.S., &c., Astley-bank, Bolton, Lancashire.
Dec. 27, 1878	Reed, John Murray, 43 Walham-grove, S.W.
June 22, 1877	Reed, John W., F.R.G.S., 27 Clarence-street, Islington, N.
June 27, 1873	Reeve, Fredk., 37 Fentiman-road, Clapham-road, S.W.
July 7, 1865	Reeves, W. W., F.R.M.S., 30 Ashburnham-grove, Greenwich, S.E.
May 22, 1874	Reid, Wm. Wardlaw, 16 Warwick-place, Peckham Rye, S.E.
Mar. 25, 1870	Richardson, Thomas Hyde, 1 Belgrave-villas, Holmesdale-road, Selhurst, S.E.
May 23, 1879	Rideout, Wm. (*Hon. Sec. Bolton Microscopical Club*), Hulliwell, Bolton.
June 25, 1869	Roberts, John H., F.R.C.S., F.R.M.S., 82 Finchley-road, St. John's-wood, N.W.
April 26, 1872	Roberts, S. Hackett, F.R.M.S., 33 King-street, Cheapside, E.C.
May 22, 1868	Rogers, John, F.R.M.S., 4 Tennyson-street, Nottingham.
Oct. 26, 1866	Rogers, Thomas, F.L.S., F.R.M,S., Selmeston-house, Thurlow-park-road, West Dulwich.
Mar. 22, 1872	Rolfe, Charles Spencer, 5 Westminster-chambers, S.W.
May 22, 1868	Roper, Freeman C. S., F.L.S., F.G.S., F.R.M.S., Palgrave-house, Eastbourne, Sussex.
June 23, 1876	Roper, Hy. John, F.R.M.S., 5 Lausanne-road, Peckham, S.E.

Date of Election.	
Oct. 27, 1876	Roper, Robert, 4 Westbury-villas, Westbury-road, Upton, Stratford.
July 24, 1868	Rowe, James, jun., M.R.C.V.S., 65 High-street, Marylebone, W.
May 23, 1879	Rowe, Thos. Smith, M.D., Cecil-square, Margate.
Oct. 26, 1866	Rowlett, John, 92 Enville-road, Walworth, S.E.
July 14, 1865	Ruffle, G. W., F.R.M.S., 131 Blackfriars-road, S.E.
July 24, 1874	Rushton, William, 61 Tufnell-park-road, Holloway, N.
Oct. 27, 1865	Russell, James, 10 High-street, Shoreditch, E.
Oct. 26, 1866	Russell, Joseph, Blenheim-house, Middle Mall, Hammersmith, S.W.
May 22, 1868	Russell, Thomas D., 21 Park-road, West Dulwich, S.E.
Feb. 22, 1867	Rutter, H. Lee, 1 St. Barnabas-villas, Lansdowne-circus, South Lambeth, S.W.
Nov. 22, 1878	Sabel, Ernest E., 185 Maida-vale, W.
May 23, 1873	Salkeld, Lt.-Colonel Joseph C., F.R.M.S., 29 St. James's-street, S.W.
Dec. 27, 1878	Salmon, C. W., 137 Graham-road, Hackney, E.
Dec. 17, 1869	Salmon, John, 24 Seymour-street, Euston-square, N.W.
Dec. 28, 1877	Sands, Chas., 5 Woburn-place, Russell-square, W.C.
May 28, 1875	Saul, Geo. William.
June 27, 1879	Sawyer, Geo. D., F.R.M.S., 55 Buckingham-place, Brighton.
Feb. 26, 1875	Scofield, W. J., M.R.C.S., F.L.S., 13 South Hill Park-gardens, Hampstead, N.W.
May 24, 1872	Sequeira, H. L., M.R.C.S., 1 Jewry-street, Aldgate, E.C.
July 27, 1868	Sewell, Richard, Ashmore-house, Keston, Kent.
Oct. 22, 1869	Shaw, Wm. Forster, Mosshall-grove, Finchley, N.
Jan. 22, 1869	Sheehy, William H., M.D., 4 Claremont-square, N.
May 26, 1876	Shepheard, Thomas, F.R.M.S., 12 Bridge-street, Row, Chester.
May 26, 1871	Sigsworth, J.C., F.R.M.S., 18 Chaucer-road, Herne-hill, S.E.

Date of Election.	
June 27, 1873	Simmonds, Joseph E.
Aug. 23, 1867	Simmons, James J., L.D.S., 18 Burton-crescent, Euston-road, N.W.
May 26, 1876	Simpson, Edwd., 24 Grummant-road, Peckham-road, S.E.
Nov. 23, 1877	Simpson, Thomas, Audley-lodge, Florence-road, Ealing, W.
Mar. 27, 1868	Simson, Thos., The Laurels, Courtyard, Eltham.
May 28, 1869	Sketchley, H. G., Bath-street, Ilkeston, Derbyshire.
Dec. 28, 1866	Slade, J., Fern-villa, Lion-rd., Bexley-heath, Kent.
Mar. 24, 1872	Smart, Harry, 8 The Paragon, Hackney, E.
Oct. 23, 1868	Smart, William, 27 Aldgate, E.
May 25, 1866	Smith, Alpheus (*Hon. Librarian*), 42 Choumert-road, Rye-lane, Peckham, S.E.
Oct. 26, 1877	Smith, Bernard E., Aucklands, Wandsworth-common, S.W.
July 25, 1879	Smith, Charles Vance, 5 Parade, Carmarthen.
Mar. 28, 1879	Smith, David, Stroud.
Feb. 25, 1876	Smith, Edward, F.S.S., St. Mildred's-house, Poultry, E.C.
Mar. 25, 1870	Smith, Francis Lys, 3 Grecian-cottages, Crown-hill, Norwood, S.E.
June 27, 1873	Smith, G. J., 73 Farringdon-street, E.C.
Oct. 26, 1866	Smith, H. Ambrose, 2 King William-street, E.C.
June 26, 1868	Smith, James, F.L.S., F.R.M,S., 233 Dalston-lane, Hackney, E.
Dec. 23, 1870	Smith, Joseph A., Granville-lodge, Croydon-road, Penge, S.E.
Oct. 26, 1877	Smith, Samuel, 331 Hackney-road, E.
Feb. 28, 1873	Smith, W. Lepard, Southfield-house, Watford.
Aug. 23, 1872	Smith, W. Stuart, 30 Loraine-road, Holloway, N.
April 24, 1868	Snellgrove, W., 58 Cranfield-road, Wickham-park, S.E.
May 24, 1878	Southey, A., 145 Fenchurch-street, E.C.
Sept. 22, 1865	Southwell, C., 44 Princes-street, Soho, W.
May 26, 1876	Southwell, Chas. Wm., 1 Stoke Newington-green, N.
Dec. 18, 1868	Sowerby, D., 38 Albert-road, Dalston, E.
May 22, 1874	Spencer, James, F.R.M.S., South-street, Greenwich, S.E.
June 26, 1876	Spencer, John, Brook's-bank, 81 Lombard-st., E.C.

Date of Election.	
Nov. 22, 1872	Spencer, Thomas, F.C.S., F.R.M.S., 32 Euston-square, N.W.
Mar. 24, 1866	Starling, Benjamin, 9 Gray's-inn-square, W.C.
Aug. 23, 1878	Steel, John Henry, M.R.C.V.S., F.Z.S., The Royal Veterinary College, Camden-town, N.W.
Feb. 23, 1872	Stevens, C. R., 7 Ashby-road, Canonbury, N.
Aug. 24, 1866	Steward, J. H., F.R.M.S., 406 Strand, W.C.
May 23, 1873	Steward, James H. C., 406 Strand, W.C.
June 22, 1877	Stewart, Chas., M.R.C.S., F.L.S., *Hon. Sec. R.M.S.*, &c. (*Vice-President*), St. Thomas' Hospital, and 25 Albert-square, Clapham-road, S.W.
Sept. 22, 1876	Stiles, M. H.
May 23, 1879	Stocken, James, 40 Euston-square, N.W.
Mar. 19, 1869	Stokes, Frederick.
July 25, 1879	Stone, Edwd. Mulready, Hill-side, West-hill, Sydenham.
Oct. 27, 1871	Stuart, David John, 53 Ferntower-road, Highbury New-park, N.
May 23, 1879	Stubbins, John, F.G.S., Chester-cottage, Old-lane, Halifax.
May 23, 1879	Sturt, Clifton, King's-college, W.C., and Melbourne University.
July 7, 1865	Suffolk, W. T., F.R.M.S., Stettin-lodge, St. Faith's-road, Lower Norwood, S.E.
June 27, 1873	Suter, Edward D., Kent-lodge, Douglas-road-north, Canonbury, N.
June 24, 1870	Swain, Ernest, 90 Campden-hill-road, W.
Nov. 22, 1867	Swainston, J. T., 3 St. Mark's-square, Regent's-park, N.W.
Nov. 24, 1866	Swansborough, E., 20 John-st., Bedford-row, W.C.
Dec. 18, 1868	Swift, James, 43 University-street, W.C.
Dec. 17, 1875	Swift, Mansell, 43 University-street, W.C.
July 27, 1877	Tanqueray, A. C., Reid's Brewery, Theobald's-road, E.C.
Sept. 28, 1877	Tarrant, Kenneth J., Litchford-house, Hatch-end, Pinner.
May 22, 1868	Tatem, J. G., Russell-street, Reading.
Jan. 23, 1874	Taylor, John Ellor, Ph.D., F.L.S., F.G.S., The Museum, Ipswich.

Date of Election.	
Aug. 23, 1878	Teasdale, Washington, Rosehurst, Headingley, Leeds.
Dec. 22, 1865	Terry, J., 109 Borough-road, S.E.
Aug. 23, 1872	Terry, Thomas, 5 Austin-friars, E.C.
July 23, 1869	Thin, James, Ormiston-lodge, Claremont-place, Brixton-road, S.W.
May 23, 1879	Thompson, Isaac Cooke (*Hon. Sec. Liverpool Microscopical Soc.*), Woodstock, Waverley-rd., Liverpool.
May 28, 1875	Thomson, John Reid, 18 Highbury-place, N.
Feb. 24, 1871	Thornthwaite, W. H., 416 Strand, W.C.
April 27, 1877	Thorpe, George, 20 Eastcheap, E.C.
Jan. 22, 1875	Tinney, William A., Ulster-cottage, Park-village-east, N.W.
Nov. 27, 1867	Tomkins, Samuel Leith.
June 23, 1871	Topping, Amos, 28 Charlotte-street, Caledonian-road, N.
July 26, 1872	Townsend, John Sumsion, F.R.M.S., Stamford-lodge, St. John's, Sevenoaks.
July 24, 1868	Tulk, John A., M.D., F.R.M.S., Burton-lodge, Staines-road, Twickenham.
July 26, 1867	Turnbull, Joseph, Laurel-house, North-hill, Highgate, N.
Aug. 24, 1877	Turner, Ernest Blaker, 46 Malmsbury-rd. Bow, E.
June 25, 1869	Turner, R. D., Chafford, Tonbridge.
June 25, 1875	Turner, Sydney, A.R.I.B.A., 7 Mark-lane, E.C.
May 25, 1877	Veasey, Robt. Geo., Ashchurch-lodge, Ashchurch-road, Shepherd's-bush, W.
July 27, 1866	Veitch, Harry, F.H.S., The Royal Exotic Nursery, King's-road, Chelsea, S.W.
Feb. 28, 1879	Venables, W., 253 Camden-road, N.W.
May 23, 1879	Vezey, John Jewell, F.R.M.S., 39 St. Donatt's-road, New Cross, S.E.
Feb. 27, 1874	Walker, John C., Highfield, Avenue-road, Crouch End, N.
July 25, 1873	Walker, John Stringer, Warwick-road, Upper Clapton, E.
June 26, 1868	Walker, J. W., Fairfield-house, Watford.

Date of Election.	
May 22, 1868	Waller, J. G., 68 Bolsover-street, Portland-road, W.
Oct. 26, 1877	Wallis, Geo. Hy., The Residences, South Kensington Museum, S.W.
Oct. 26, 1877	Walters, W., B.A. Lond., Lime-villa, Lewisham-road, Forest-hill, S.E.
Aug. 26, 1870	Warburton, Samuel, Merton-villa, New-road, Lower Tooting, S.W.
Nov. 22, 1867	Ward, F. H., M.R.C.S., F.R.M.S., Springfield-house, near Tooting, S.W.
June 28, 1878	Ward, Richard John, Silver-street, Lincoln.
Dec. 18, 1868	Warner, Alfred, care of Mr. W. F. Stanley, 13 Railway-approach, London-bridge, S.E.
May 25, 1866	Warrington, H. R., 7 Royal Exchange, Cornhill, E.C.
July 25, 1879	Waterman, Thos. L., 103 Antill-road, Bow, E.
Oct. 27, 1865	Watkins, C. A., 10 Greek-street, Soho, W.
Oct. 25, 1872	Watkins, J., L.C.P., 40 Store-street, Bedford-square, W.C.
Aug. 23, 1878	Watson, Geo. F., 313 High Holborn, W.C.
Sept. 28, 1877	Watson, Thos. P., 313 High Holborn, W.C.
Dec. 28, 1877	Watson, Thos. W., 4 Pall Mall, S.W.
May 23, 1879	Watts, The Rev. G. E., M.A., F.R.M.S., Kensworth, Dunstable, Herts.
Dec. 28, 1866	Way, T. E., 65 Wigmore-street, W.
Oct. 26, 1877	Weatherley, Capt. H. C. S., 64 Cheapside, E.C.
July 24, 1874	Webb, C. E., Wildwood-lodge, North-end, Hampstead, N.W.
April 25, 1879	Webster, Hy. Wm., M.D., St. George's Infirmary, Fulham-road, West Brompton, S.W.
May 24, 1867	Weeks, A. W. G., 36 Gunter-grove, West Brompton, S.W.
Sept. 27, 1878	West, Robt. G., 39 Lombard-street, E.C.
Feb. 25, 1876	Wheeler, George.
May 23, 1879	Wheldon, John, 58 Great Queen-street, Lincoln's-inn-fields, W.C.
April 23, 1869	White, Charles Frederick, F.R.M.S., 42 Windsor-road, Ealing, W.
Feb. 26, 1868	White, Francis W., 5 Gipsy-hill-villas, Gipsy-hill, S.E.
May 22, 1868	White, T. Charters, M.R.C.S., L.D.S., F.R.M.S., 32 Belgrave-road, S.W.

Date of Election.	
July 25, 1873	White, Walter, Litcham, Norfolk.
May 23, 1873	Whitmore, John, M.D., 15 Wimpole-street, W.
June 25, 1875	Whitney, Edward Underwood, 13 Great College-street, Westminster, S.W.
July 24, 1868	Wight, James F., F.R.M.S., Grazeley, Gipsy-hill, Upper Norwood, S.E.
Mar. 24, 1871	Williams, George, 1 Devonport-road, Shepherd's-bush, W.
Nov. 23, 1877	Williams, Geo. Sawyer, 10 Clifton-villas, Maida-hill, W.
April 23, 1875	Williams, Henry, Victoria Nurseries, Upper Holloway, N.
June 23, 1876	Williams, Jas. W., New-court, St. Swithin's-lane, E.C.
Oct. 24, 1873	Williams, John R., F.R.M.S., 59 Albion-road, Stoke Newington, N.
June 27, 1879	Willson, James, 2 Oval-road, Regent's-park, N.W.
May 24, 1878	Wilmer, Horace, Chelmsford-rd., Woodford, Essex.
Mar. 24, 1876	Wilson, Chas. Joseph, 14 Highbury-crescent, N.
Feb. 22, 1867	Wilson, Frank, 110 Long-acre, W.C.
Jan. 24, 1879	Wilson, S. K., F.R.G.S., M.R.I., 3 Portland-terrace, Regent's-park, N.W.
June 27, 1879	Wood, Francis, 63 Mayfield-road, Dalston, E.
Aug. 27, 1869	Woods, W. Fell, 1 Park-hill, Forest-hill, S.E.
Jan. 28, 1876	Woollett, John, 58 Cloudesley-road, Islington, N.
Oct. 25, 1867	Worthington, Richard, Champion-park, Denmark-hill, S.E.
June 27, 1873	Wrey, George E. B., Addington-house, Addington-road, Reading.
May 25, 1877	Yates, Francis, Rockwood, Surbiton-hill.
Jan. 25, 1878	Yates, Robert, 64 Park-street, Southwark, S.E.
Oct. 26, 1866	Yeats, Christopher, Mortlake, Surrey, S.W.

NOTICE.

Members are requested to give one of the Hon. Secretaries early notice of any change of Residence, so as to prevent miscarriage of Journals and Circulars.

RULES.

I.—That the Quekett Microscopical Club hold its meetings at University College, Gower Street, on the fourth Friday Evening in every month, at Eight o'clock precisely, or at such other time or place as the Committee may appoint.

II.—That the business of the Club be conducted by a Committee, consisting of a President, four Vice-Presidents, a Treasurer, one or more Honorary Secretaries, an Honorary Secretary for Foreign Correspondence, and twelve other members,—six to form a quorum. That the President, Vice-Presidents, Treasurer, Secretaries, and the four senior members of the Committee (by election) retire annually, but be eligible for re-election. That the Committee may appoint a stipendiary Assistant Secretary, who shall be subject to its direction.

III.—That at the ordinary Meeting in June, nominations be made of Candidates to fill the offices of President, Vice-Presidents, Treasurer, Honorary Secretaries, and vacancies on the Committee. That such nominations be made by resolutions duly moved and seconded, no Member being entitled to propose more than one Candidate. That the President, Vice-Presidents, Treasurer, Honorary Secretaries, and Honorary Secretary for Foreign Correspondence be nominated by the Committee. That a list of all nominations made as above be printed in alphabetical order upon the ballot paper. That at the Annual General Meeting in July all the above officers be elected by ballot from the candidates named in the lists, but any member is at liberty to substitute on his ballot-paper any other name or names in lieu of those nominated for the offices of President, Vice-Presidents, Treasurer, Honorary Secretaries, and Honorary Secretary for Foreign Correspondence.

IV.—That in the absence of the President and Vice-Presidents the Members present at any ordinary Meeting of the Club elect a Chairman for that evening.

V.—That every Candidate for Membership be proposed by two or more Members, who shall sign a certificate (see Appendix) in recommendation of him—one of the proposers from personal knowledge. The certificate shall be read from the chair, and the Candidate therein recommended balloted for at the following Meeting. Three black balls to exclude.

VI.—That the society include not more than twenty Honorary Members, elected by the Members by ballot upon the recommendation of the Committee.

VII.—That the Annual Subscription be Ten Shillings, payable in advance on the 1st of July, but that any Member elected in May or June be exempt from subscription until the following July. That any Member desirous of compounding for his future subscription may do so at any time by payment of the sum of Ten Pounds; all such sums to be duly invested in such manner as the Committee shall think fit. That no person be entitled to the full privileges of the Club until his subscription shall have been paid; and that any Member omitting to pay his subscription six months after the same shall have become due (two applications in writing having been made by the Treasurer) shall cease to be a Member of the Club.

VIII.—That the accounts of the Club be audited by two Members, to be appointed at the ordinary Meeting in June.

IX.—That the Annual General meeting be held on the fourth Friday in July, at which the Report of the Committee on the affairs of the Club, and the Balance Sheet duly signed by the Auditors shall be read. Printed lists of Members nominated for election as President, Vice-Presidents, Treasurer, Secretaries, and Members of the Committee having been distributed, and the Chairman having appointed two or more Members to act as Scrutineers, the Meeting shall then proceed to ballot. If from any cause these elections, or any of them, do not take place at this Meeting, they shall be made at the next ordinary Meeting of the Club.

X.—That at the ordinary Meetings the following business be transacted:—The minutes of the last Meeting shall be read and confirmed; donations to the Club since the last Meeting announced

and exhibited; ballots for new Members taken; papers read and discussed; and certificates for new Members read; after which the Meeting shall resolve itself into a conversazione.

XI.—That any Member may introduce a Visitor at any ordinary meeting, who shall enter his name with that of the Member by whom he is introduced in a book to be kept for the purpose.

XII.—That no alteration be made in these Laws, except at an Annual General Meeting, or a Special General Meeting called for that purpose; and that notice in writing of any proposed alteration be given to the Committee, and read at the ordinary Meeting at least a month previous to the Annual or Special Meeting at which the subject of such alteration is to be considered.

APPENDIX.

Form of Proposal for Membership.

Quekett Microscopical Club.

Mr.
of
being desirous of becoming a Member of this Club, we beg to recommend him for election.

(*on my personal knowledge*).

This Certificate was read 18
The Ballot will take place 18

MEETINGS

OF THE

QUEKETT MICROSCOPICAL CLUB,

AT

UNIVERSITY COLLEGE, GOWER STREET, LONDON.

1879.—August	8	....	22
September	12	....	26
October	10	....	24
November	14	....	28
December	12	....	*
1880.—January	9	....	23
February	13	....	27
March	12	....	†
April	9	....	23
May	14	....	28
June	11	....	25
July	9	....	23

* December 26—No Meeting.

† March 26—Good Friday, No Meeting.

The Ordinary Meetings are held on the *fourth* Friday in each month:—business commences at 8 o'clock p.m.

The Meetings on the *second* Friday in the month are for Conversation and Exhibition of Objects; from 7 to 9.30 p.m.

The Annual General Meeting will be held on July 23rd, 1880, at 8 o'clock, for Election of Officers and other business.

EXCURSIONS, 1879.

March 22nd.	WANDSWORTH. To meet at Clapham Junction at 3 o'clock.
April 5th.	SNARESBROOK. To meet at Liverpool Street Station.
April 19th.	TOTTERIDGE, returning by Mill Hill. To meet at Moorgate Street Station.
May 3rd.	BROMLEY, for KESTON. To meet at Holborn Viaduct Station.
May 17th.	CATERHAM, for GODSTONE. To meet at Cannon Street Station.
May 31st.	RICKMANSWORTH. To join the Watford Club. To meet at Euston Station, 1.45 Train.
June 14th.	WEYBRIDGE. To meet at Waterloo, Suburban Station, Main Line.
June 19th.	EXCURSIONISTS' ANNUAL DINNER. Arrangements will be duly announced.
June 28th.	BROXBOURNE. To meet at Liverpool Street Station.
July 5th.	BRIGHTON, DAY EXCURSION. To meet at London Bridge Station (Aquarium Train), 9.50 a.m.
July 12th.	HAMPTON COURT. To meet at Waterloo, Suburban Station, Main Line.
July 26th.	HOMERTON. To meet at Broad Street Station, at 3 p.m.
Sept. 6th.	NORTHFLEET, for SWANSCOMBE. To meet at Cannon Street Station.
Sept. 20th.	CHISLEHURST. To meet at Charing Cross Station.
Oct. 4th.	BARNES. To meet at Waterloo Station, Richmond Line.

The time of departure from Town, unless otherwise specified, will be THE FIRST TRAIN AFTER TWO O'CLOCK.

F. W. Gay,
F. Oxley,
W. W. Reeves,
T. Rogers,
J. Spencer,
} Excursion Committee.

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